CAPITAL NEEDS IN THE AGRICULTURE OF SOUTH VIETNAM

By

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This study examined the effects of capital constraints on the development of Vietnam's agricultural sector. Improvement of agricultural production and incomes is closely tied to the increased use of capital. The major objective of this study is to investigate the productive capacity of Vietnam's agriculture so as to maximize national agricultural income. A linear programming model was developed which encompassed production capacity, consumption, marketing, and production and distribution facilities. Optimum capital investment was generated in connection with the standard national model, as well as models of the six regions of the Delta, East, Lower Coast, Central Coast, North Coast and Highlands, plus a geographically reduced model which included only the Delta region and one half of East region. Capital constraints of 50% and 10% of optimum capital were imposed. Comparisons of these optimum solutions were made.

Capital constraints have an impact on agricultural production. Most of the decreased output emanates from decreased rice production

as capital is reduced. A shift from high-yielding rice to non-floating rice occurs as a result of capital reductions. Nevertheless, the agriculture of Vietnam still continues to center around rice production. Corn is relatively sensitive to reductions of capital. Sorghum, however, is insensitive as capital investments are reduced considerably below optimum levels. Soybeans come into the reduced model and its 50% of capital constraint solution. Peanut production expands as capital investments are reduced. Sugarcane production disappears in a relatively early stage of capital reduction in the standard national model. Tobacco production increased slightly as capital was reduced. Rice, sorghum and rubber come into all solutions and in large quantities. Tea is slightly affected by capital reductions in the standard national model. Coconut output is insensitive in the capital constraint solutions of the standard national model, while it increases with capital reductions of the reduced model. Pineapple production expands as capital is reduced. Banana production is only slightly affected by capital reductions in the standard national model. Jute is sensitive to capital reductions. Duck feathers, ducks and chicken eggs seem insensitive to capital reductions. Although feed supplies are adequate, large scale commercial poultry and swine production do not appear in the optimum solutions, whereas large scale commercial duck production does enter every solution. Commercial beef cattle enterprises do not come into any solution.

When capital investments are reduced, production and distribution facilities decrease. This causes production and agricultural incomes to decrease, exports to fall and imports and trade deficits to increase. But the computer solutions indicated that capital investment could be reduced considerably below optimum levels without appreciably affecting

income levels. This does not mean that the capital factor is not important but that the historical land resource base (existing land plus the return of abandoned land) does not provide a basis for much economic development. In the capital constraint solutions of the standard model, the historical land resource base does not permit self-sufficiency in production of both rice and livestock. In the reduced model, however, the solutions involving capital constraints still permit self-sufficiency in the production of both rice and livestock, except beef production, because the Delta region is extremely productive. The productive potential of the historical land resource base for Vietnam generally could be increased through measures to improve water control and irrigation, plus reduction in the effects of salt water intrusion. These developments require large expenditures of public development capital.

In order for Vietnam's agriculture to become the vehicle that stimulates economic growth, ways must be found to economically increase agricultural output, income, and efficiency. Given the present situation in Vietnam, increases in production and incomes are closely tied to increased uses of capital.

CHAPTER I
INTRODUCTION

The Problem

Productivity and relative availability of various resources are key elements in an analysis of optimum resource allocation. Capital is a scarce resource. Therefore, capital is generated as a requirement for each of the situations examined. For development planning purposes, this procedure serves a useful purpose, since capital represents the major external input required for agricultural development. Capital investment in this study is for production and distribution facilities.

South Vietnem faces two major problems with respect to primary commodities: a production-distribution problem and an export problem. If the "Green Revolution" made possible by improved new strains of rice is to be achieved, an ever expanding investment in flood control, irrigation and other infrastructure facilities, as well as in fertilizers and insecticides, will be required. Moreover, the bumper crops, if and when produced, cannot adequately be distributed unless road and warehousing facilities are greatly expanded and improved. Shortage of the necessary capital has been one of the key problems of agriculture in Vietnam. Indeed, capital is usually hard to accumulate on a small farm in Vietnam, Asia or elsewhere. Not until a farmer obtains an adequate supply of money or its equivalent, credit, can he invest in the machinery and material needed for modern, efficient farming. Some examples of materials and machinery needed to improve the efficiency of Vietnamese

agriculture include irrigation pumps, fertilizers, insecticides and spraying machines and tractors.

Agriculture is an integral part of the economy of Vietnam. About two million families live on small scale farms with small rice fields of about two hectares or less. The majority of farmers are poor, and they use traditional farming methods with members of the family employed as laborers. Their income is just enough for their daily living. It is extremely difficult, if not impossible, for them to build up capital reserves. Also, the family way of life still prevails in the countryside and very few rural families are willing to change their lifestyle because of risks of price changes or crop failure.

South Vietnam remains a food deficit country. Agricultural surpluses are needed to aid development but such surpluses seem unattainable at the present time.

Capital is a major obstacle to increased agricultural production. Credit, however, has not been expanding for several reasons. There is a lack of government funds to provide subsidized farm credit, as well as private capital for farm credit. Farmers have an aversion to risk, lack adequate information, and are generally fearful of government programs. Other factors contributing to a shortage of agricultural credit include the following: large amounts of external funds have recently been absorbed by the agricultural credit systems, high interest rates in the informal credit market, and the high credit propensity of new agricultural technology.

Despite a credit shortage, the absolute amount of credit available has increased substantially. However, institutional funds in Vietnam have not covered total loan requests. Since rather low rates of interest

are often charged on agricultural loans, it is unclear whether rates of interest closer to the marginal efficiency of capital would still result in excess demand. It has been usually held that private individuals, money lenders, and merchants provide a large part of total rural credit in less developed areas. In India, for example, studies have shown that less than 20 percent of total rural credit is furnished by the formal credit system. In Thailand only five percent of the agricultural credit was reported coming from institutional lenders.

The amount of noninstitutional credit in the rural areas of Vietnam is not sizeable. If there is a large segment of economically justified demand for agricultural credit, the noninstitutional money markets apparently have not exploited the opportunity. One could ask, "Does the lack of a sizeable informal credit system indicate a deficiency in effective demand?"

High interest rates in the informal credit market also have been cited as indicating a credit shortage. That is, demand pressures face a small pool of loanable funds embodied in a highly inelastic supply schedule. It is therefore concluded that competition for these funds has driven interest rates up and resulted in monopoly profit for owners of loanable funds. Another aspect of this question is that relatively high rates of interest may be justified on loans in the informal credit market. The bulk of these loans are small, short term, unsecured, and mostly for consumption, and lenders' administrative costs are therefore high. It may well be also that the current noninstitutional credit is supplying a market that is largely unrelated to the market for productive agricultural inputs. Thus, marginal costs for credit in this market may

be of little or no value in determining the marginal productivity of capital used for agricultural inputs.

Credit shortage is one of the major bottlenecks causing low land and labor productivity in traditional agriculture. Not only does a current shortage of production credit exist, but the future transformation of less-developed agriculture will also require major credit infusions.

Concessional lending arrangements for farm credit are justified because farmers have been exploited by lenders who charge exorbitant rates of interests, most traditional farmers need special inducements to use highly productive inputs for which credit is necessary, and low interest rates are further justified as an income transfer mechanism and/or to offset fiscal or pricing policy that adversely affects farmers.

There is little savings capacity in rural areas and marginal propensities to save are low. Almost all funds for credit, therefore, must come from outside the agricultural sector. Several important conclusions follow from these observations:

1) little investment takes place on farms in traditional agriculture;

2) most investment that does take place must be financed by credit provided from sources outside of agriculture;

3) mobilization of capital from the agricultural sector must be largely done on an involuntary basis;

In short, capital is a major obstacle to agricultural development. How to obtain capital for Vietnamese agriculture and how to allocate it among uses to maximize national income are among the most important questions South Vietnam faces.

Objectives

The objectives of this study are as follows:

1. To examine the productive capacity of South Vietnam's agriculture so as to maximize national agricultural income. Tailor a linear programming model to the particular conditions and problems existing in South Vietnam by using the 1973 prices of inputs and commodities. Specify resources and define production relationships among resources, enterprises, and regions, which also explicitly reflect processing, marketing, transportation, and consumption phenomena and relationships.

2. To recalculate optimum solutions with assumed constraints on capital for the complete model (including the six regions of the Delta, East, Low Coast, Central Coast, North Coast and Highlands) and for the reduced model (only Delta and one half of East region). Capital constraints of 50 percent and 10 percent of optimum capital from these optimum solutions are imposed. A comparison of the optimum solutions of the complete and reduced models is made.

Review of Literature

The literature review is divided into two parts: (1) internal capital formation, income, and growth, and 2) external capital as related to credit institutions.

Internal Capital Formation

Schwartz [42] used a linear programming model to determine maximization of rate of return to owned capital. Solutions of each of the programs were calculated for many combinations of machinery and capital input levels.

Langham [24] used a dynamic linear programming model to determine farm growth potential in British Honduras. The model maximizes the present value of net returns over a three-year planning horizon. Net returns as used in the model mean returns to labor and capital above all production and living expenses. Returns, therefore, are actually accumulations of liquid capital assets.

A classic study of capital formation in agriculture by Tostlebe [47] covers the 1870-1950 period. This study concluded that major amounts of farm capital come from public land grants and savings from gross income of farmers. A relatively minor part came from credit institutions. The capital structure of farms, on the average, showed certain likenesses and differences as indicated by the regional data. Moreover, comparison of the regional data can show in a rough way what would be involved in the way of capital formation per farm if some region that hitherto has specialized in field crops such as cotton or wheat were to change its major interest to dairying or livestock feeding.

The type of farming has changed far less than the techniques, and changes in the latter have been especially influential determinants of the use of capital in farming. In general the percentages give the impression that real estate has become somewhat less important, machinery and power somewhat more important, in the whole of physical farm capital. And it appears that it is the growth of machinery, influenced perhaps largely by the improvements in the farm tractor and by the substantial migration of farm workers to the cities, that is one of the main reasons for this change in the composition of physical farm capital.

Kuznets [23], in a companion study to Tostlebe's, examined capital formation and financing in the American economy. He suggested that a main determination of capital formation is to be found in factors affecting the savings process rather than exclusively in the demand for capital funds. He argued the need for theoretical work to explain the levels and trends in the proportion of capital formation to national product because his research showed a decreasing proportion of capital formation to national product over the 1869-1955 period.

Plaxico used dynamic linear programming to study management strategies in Great Plains farming. His optimum program called for the borrowing of less capital than the maximum amount of funds available. It is significant to note that since borrowed capital substitutes for owned capital at a linear rate, the discount rate for borrowed capital is less than that for owned capital by the market rate of interest [51].

Curnutt and Ferber [12], in a study of financial stock-flow relationships among Central Illinois farmers, found that both assets and debts are widely dispersed. In terms of dollar value, most of the farmers' assets were in the operated farm, principally in land and buildings. The most important sources of funds for Central Illinois farmers were receipts from the sale of crops and livestock and increases in indebtedness. Most funds for financial transactions were used to meet expenses and to pay off debts, although sizeable amounts also went back into the farm.

Martin and Plaxico [28], in a polyperiod analysis of growth and capital accumulation of farms, showed that a criterion function of maximizing the present value of land investments resulted in a slower

rate of growth than an objective of maximizing net return. This occurred because maximum net returns resulted from renting land only. Although the average cost of buying land (interest payments over the 30-year planning horizon) is less than renting, the total capital outlays (interest plus principal payments) are higher. Therefore, buying land resulted in slower rates of growth and lower total net returns. Linear programming techniques in a polyperiod framework were used in this study to depict the growth of the farm firm.

Perkins and Witt [33] concluded that capital formation may take quite different forms depending on the stage of agricultural development. When agriculture is characterized by unused resources, scarce capital, and surplus labor, a major part of capital formation occurs in the form of nonpurchased capital produced with surplus labor. In a second stage of development when there exists little slack in unused natural and labor resources, social overhead capital investments became relatively more important. In a third stage of development characterized by American agriculture, expected capital formation would occur concurrently as a substitute for labor, for resource development, and for infrastructure and social overhead.

Johnson [20] described four factors affecting agricultural capital formation. First, farm capital formation takes place rapidly when farmers are in a position to gain from reinvesting part of their income and when they have the responsibility for the investment decision concerning farm production. Second, rapid capital formation occurs when the public makes substantial investments in both the general and technical education of farmers, in improved technology for farming, and in extension of that technology to farmers. Third, formation of farm capital is accelerated

when the transfer of capital from farm to the non-farm sector is left to voluntary processes, including transfers in the form of inherited, monetary capital, as well as training received by farm children who migrate to non-farm occupations. Fourth, lagging farm capital formation can be stimulated with favorable price programs and credit assistance to individual farmers.

Baker and Hopkin [5] suggested a model for farm capitalization which related growth of the farm firm to rate of return on assets, financial leverage, and the farm family consumption function. They postulate that the incentive for a farmer to invest in his farm, to borrow for investment, or to save from consumption stems directly from the rate of return he can obtain in his business. Similarly, Adams and Singh [2] focused on the firm-household decision-making process as being vital for explaining rural capital formation. Tinnermeier [46] also reminds us that for small farmer credit programs to be successful, new technology must be profitable for the small farmer.

Johnson and Quance [21] explain agricultural capital formation in an economic framework of substitution of capital inputs for labor and land in response to rising wage rates and rising land values, plus the response on the part of farmers to expected marginal value productivities (MVP's) for capital investment that were in excess of acquisition costs. Their study concluded that overcommitment of capital in agriculture resulted because ex post MVP's were lower than ex ante MVP's.

Melichar [29], in the study of demand and supply of farm capital, presents a refinement of some of his earlier efforts and builds on earlier work by Tostlebe, Johnson, Brake, and others. Melichar found that a capital subsidy has the effect of lowering the cost of capital

relative to labor, while a wage subsidy changes relative factor costs in favor of labor. Also, it was found that as capital costs relative to labor costs decline, firms substitute in favor of capital. The substitution effect against labor due to a lowering of capital costs must be compensated for by an expansion of total industry output if total employment is to increase.

Lee [26] studied the intersectoral capital flows in the economic development of Taiwan for the period 1895-1960. It was determined that traditional peasant agriculture prevalent in Asia can increase output and productivity at a sufficiently rapid rate so that it can generate surplus or savings to be transferred for investment to the modern industrial sector. The basic agricultural investment should be accompanied by technological improvement. An appropriate investment scheme with large labor input and less input of capital goods should be selected and a capital transfer mechanism should be established.

Pasour, McPherson, and Toussaint [34] investigated the effects on farm production and income of varying resource situations in the Northern Piedmont, North Carolina area in terms of land, labor, and capital.

Plaxico and Goodwin [37], working in the area of resource minimization, compared specified incomes on fine textured soils of Southwestern Oklahoma, the Delta region of Arkansas, Mississippi, and Louisiana, and parts of North Carolina. Strickland and Tyner [44] continued the research by using the model and many of the assumptions of the work of Plaxico and Goodwin. Strickland and Tyner assumed that land investment was the largest proportion of the total capital requirement

so that minimizing the capital requirement and minimizing land requirement gave almost identical solutions. It was also assumed that feed required for livestock production would be produced on the farm. Relying on these basic assumptions, land requirements were used as indicators.

Nelson [31], in the study of the financial aspects of growth of the farm firm in the West, showed that the greater use of credit may well contribute to growth of the farm firm. An increase in land values increases the credit base thereby contributing to growth of the firm; it also retards growth by increasing the amount of credit needed for growth and by reducing the rate of return on capital in business, assuming the increase in land values is not matched by inflation in commodity prices. Moreover, depreciation reserves provide a substantial amount of capital for use in the farm business.

A firm growth model developed by Odell L. Walker and James R. Martin [48] dealt with finance, managerial capacity, imperfect knowledge, time, and what may be called, the metabolism of the farm. It was determined that costs are important not only in affecting practice and enterprise choice, but in determining capital withdrawals and flows. Moreover, all capital use activities and withdrawals must be identified temporally and tied to cash flow and borrowed capital limits. Certain problems of adapting linear programming techniques to the firm growth framework and simulation were covered.

Walker and Martin [48] demonstrated that application of several decision models to agricultural problems can result in recommendations suited to a wide range of farmer situations. The study also demonstrated that data representing the influence of many possible levels of uncontrollable and unpredictable natural variables are needed for application of relevant models for decision-making under uncertainty.

In a study by Lorensen [27] on capital productivity and management performance in small farm agriculture in Southern Brazil, marginal value productivities estimated for operating expense capital, working asset capital, and their respective components, were found to have a positive net marginal value product for all farm size groups. The marginal returns of aggregate farm working capital slightly exceeded marginal costs for all size groups. Among individual components, unmechanized equipment was found to be a profitable item for all farm size groups. Mechanized equipment had a negative marginal product for small farms and positive returns for the other two size groups. In summary, results of the study demonstrate that additional land resources are not necessarily the initial prerequisite to increasing agricultural production on the farms studied. Rather, the increased use of operating expense and working asset capital, together with better managerial performance, could significantly stimulate agricultural production. In the small farm agriculture in Southern Brazil, the greatest returns are to be realized from expansion at the intensive margin of production. Therefore, programs designed to stimulate agricultural production should first encourage the efficient use of additional high return capital inputs on existing farm units.

In the study by Zarka [49] on product, capital, and productivity in Syrian agriculture, the estimated exponents of labor and capital in the agricultural production function are roughly equal to the 1963 relative shares of labor and capital in Syrian agriculture. This equality lends credence to the hypothesis that factor markets in Syrian agriculture are generally competitive. Consequently, the removal of market imperfections is unlikely to result in significant improvement in the standard of living of rural labor.

Pittman [35], in a study of capital budgeting to evaluate selected investment alternatives in the processing of Southern U.S. vegetables, showed that under conditions of capital rationing the number and quality of investments selected were severely limited. When the capital budget was small, the firm often was forced to select smaller and less productive sets of activities due to an inability to finance the larger project. High interest rates also tended to severely restrict investment selection, even in instances of unlimited capital availability.

In the study of firm growth simulation as a farm management and credit evaluation device, the information generated by the model should aid the farm manager in choosing the land acquisition method, production plan, financial arrangements, equity level, and consumption level which will provide the desired rate of firm growth [16].

External Capital as Related to Credit Institutions

One effort to study the effects of national monetary and credit policies on agricultural investment and production was made by Doll [13]. His empirical analysis of the 1950's concluded that easing of monetary conditions, e.g., increasing the money supply, would not be beneficial to agriculture.

Contrary to Doll's results, Gramm and Nash [17] found that agricultural incomes and investments have been responsive to changes in the money supply in the same manner as nonfarm incomes and investments.

Finn [15], in a study of supervised agricultural credit in Peru, found that while most farmers did try farming with the use of fertilizer and improved seed, many reverted to farming without the use of these

modern inputs. Furthermore, it was concluded that mere adoption of the use of fertilizer, although correlated with the use of other modern inputs, cannot be taken as an indication of program success. Adopters did not generally show greater increases in farm income than non-adopters. Improvements in physical productivity and farm incomes were slight.

In the study by Larson, Stauber, and Burt [25] on economic analysis of farm firm growth in North Central Montana, the analysis indicated that the expansionary alternative, purchase of 320 acres of cropland and associated machinery, equipment, and buildings, was optimal regardless of the initial debt and capacity level of the winter wheat farm, given no credit restrictions on the firm's ability to borrow. This decision rule indicated that the operator should be a "plunger--go for broke" and hope the expected outcome will improve over the planning period without the firm going bankrupt. As the initial debt decreased and initial capacity increased, the firm's ability to save or obtain reinvestable funds improved. The increase in investable funds reduced the need for borrowed funds and enhanced the firm's ability to accumulate capital in the form of net worth and reduced the probability of bankruptcy. The results indicate that the firm's survival ability, defined as one minus the probability of bankruptcy, is dependent on the firm's initial capacity and debt situation, the cost of the investments in terms of price paid for land, the decision alternative, interest paid for borrowed funds, and the level of consumption and other expending. Increases in the consumption expenditure and interest paid for borrowed funds decreased the probability of survival, particularly when both of these costs were increased together.

Nisbet [32] described the rural credit market in Chile as consisting of an institutional market and an informal credit market. The well-to-do farmers were served by the banks in the institutional market while poor farmers utilized the informal, higher cost, credit market.

Baker, Hopkin, and Brinegar [4] suggest financial intermediation can be viewed as buying funds with one set of maturities and selling funds with another set of maturities. They also have argued for the use of models to describe the functioning of financial markets.

More recently, Barry and Hopkin [7] have suggested a resource allocation model to examine the behavioral properties of financial intermediaries. Their model is basically a multi-period LP approach including attention to liability management options, asset management options, and constraints.

A study by Swackhamer and Doll [45] examined the distribution of bank credit flows in relation to the economic and institutional environment. Their data suggested considerable immobility in bank credit flows in rural areas both by regions and through time. They also identified considerable inflexibility in interest rates. Swackhamer and Doll noted that participation loans increased by a factor of seven in the decade before 1966. They viewed this as an attempt by banks to adjust to, and keep pace with, the increasing financial requirements of agriculture. Yet they question whether the participation loan has potential for meeting future agricultural credit needs.

Baughman [8] concluded that adequate credit has been available to agriculture since there have been rapid increases in investment per worker and in output per worker. Also, he argued that the low rate of

return on capital in agriculture suggested easy capital availability. He concluded that financial intermediaries have performed their roles reasonably well.

Sloan [43] agreed that existing financial intermediaries have performed reasonably well. At the same time, he pointed to imperfections in financial markets. He cited as examples the relative inflexibility in the price of agricultural credit compared with the price of credit in other sectors of the economy and a significant disparity in interest rates on agricultural loans among geographical areas. Further, he suggested that the rapid increase in the proportion of credit held by noninstitutional lenders may be symptomatic of shortcomings in the money markets. He also stated that legal restrictions often interfere with the free flow of capital resources.

Brake [11] suggested that the market for rural savers may also have inadequacies. In many rural areas the alternatives for savers are extremely limited and often provide only relatively low returns. The quality of information and access to investment information are more limited in rural areas than in urban areas.

In the study by Sansom [40] on the economics of insurgency in the MeKong Delta of Vietnam, his compact discussion of the village credit structure emphasized the importance of unorganized money markets for peasant producers but also the impact of government-sponsored credit. Sansom concludes that the credit market was relatively open and that interest rates, although high, were probably not a reflection of credit-market control. He finds landlords, moneylenders, and merchants unimportant in 1966 and shows that the predominant sources of credit were relatives, the government and the hui--the revolving credit

association of Chinese origin found with various modifications throughout Southeast Asia. His analysis of the changing rice market illustrates how freeing a market can improve income distribution.

Qamar [38] tried to analyze some comparative legal-institutional aspects of agricultural credit systems in selected countries, particularly Pakistan. The dissertation ends with concrete proposals for the renovation of agricultural credit institutions in Pakistan. A crop loan scheme of supervised credit is also set forth whereby the bank and the cooperative societies act in unison. Crop insurance and effective price support are also recommended. And finally, a continuous land reform program is viewed as a concomitant to agricultural credit for which the role of the law and the lawyer is stressed.

Rao [39] studies the economics of agricultural credit-use in Southern Brazil. It was concluded that credit needs of traditional farms are limited and transformation of agriuclture requires considerable amounts of credit. The general finding of this analysis was that the degree of underinvestment in operating expenses was higher on small farms while the level of credit use was lower. It was, therefore, concluded that there were profitable investment opportunities on small farms but these firms were facing external rationing.

Results of the study of Early [14] demonstrates that agri-business firms in Brazil have need for additional credit in order to provide improved service to the farmer clientele, that they are a major source of credit to farmers, and that they have access to sources of financing not available to farmers. Also, the farmers are a source of financing to the agri-business firms through a system of delayed payments for delivering products.

In the study of Kim [22], on the structure and functioning of rural credit in Korea, the growing needs of rural credit can be financed by mobilization of internal farm savings, strengthening of cooperative financing programs, diversion of capital from other uses and sources, and government programs and foreign capital.

Adams [1] examined agricultural credit in Latin America. An evaluation of a supervised credit program in Colombia further suggests that a number of small farmers can profitably absorb more credit. Several recent studies in India also strongly suggest that credit requirements dramatically increase when new technology is used [1]. Additional fertilizer purchases, changes in irrigation systems, and more employed labor associated with use of new seed varieties may require a two- to four-fold increase in cash costs. Again, a review of various studies of interest rates charged in the informal credit markets in rural Latin America strongly suggests that interest rates at best are weak indicators of production credit shortage. It may be that the importance of extremely high rates of interest in the informal credit markets in Latin America has been greatly overstated.

In another work on rural financial markets, Hayenga [18] analyzed the effects of rural bank mergers on the services offered to citizens of the rural community. As a result of bank mergers, customers had access to a wider variety of services from the bank. New services were offered by merged banks that were not offered by independent banks. Both the market for loans and the market for savings became more closely tied to money market conditions. With bank mergers, loan eligibility requirements became more liberalized so that a wider range of people became eligible for loans.

Barla [6] studied cooperative agricultural credit institutions in India. It was empirically shown that the marginal value product (MVP) of purchased inputs was very much higher than that of the farm grown inputs. Conversely, the MVP of labor was close to zero or negative. Cross section analysis revealed that unless technological improvements are introduced, an increased supply of credit may imply a wasteful use of capital on small farms (having less than 2.5 hectares). On the other hand, under the existing state of technology, availability of more credit will help medium sized farms (having 2.51 to 6.00 hectares) optimize the use of capital. Thus, technology is a constraint on small farms, whereas credit is relatively more critical on medium size farms.

Nehman [30] studied small farmer credit usage in a depressed community of São Paulo, Brazil. It was shown that informal lenders dominated the small loan business, serving both small and medium sized farmers. The primary advantage of dealing with small lenders was that the money was available on request. It was shown that small bank loans were costly both to the banks and to the farmers. Informal lenders were highly competitive in price on small sized loans, even though the formal interest rate was one-half to one-fourth as high as the informal rate. Based on this analysis it was shown that small farmers did not have significant opportunities to increase their use of profitable agricultural inputs. The opportunities that did exist were primarily on larger farms and farms that already were participants in the subsidized credit program.

Schluter [41] studied the interaction of credit and uncertainty in determining resource allocation and incomes on small farms in India. He mentioned that the chief problem of the small farmer on irrigated land

is a shortage of working capital. This arises from a lack of collateral against which to borrow, and lack of a willingness to use available credit owing to income uncertainty. On unirrigated small farms uncertainty is the main constraint because inadequate assets and funds to finance consumption make farmers unable to sustain the large income fluctuations of high-income crop combinations. Analysis indicates that shortage of working capital prevents small farms from growing the high-income crop, sugarcane. The study concludes that expanding cooperative credit availability would increase fertilizer use and encourage a shift to higher income crops (new varieties and sugarcane) on irrigated small farms. Greater flexibility of loan repayment would make small farmers more willing to use available credit.

Bhargava [9] examined the effect of publicly supported credit programs on economic growth of small farmers in India. Available information for India indicates that small farms have, by and large, stayed out of the reach of the publicly supported credit programs and continue to depend on high cost informal lenders. The failure of the publicly supported credit programs to reach the small farmers and displace their dependence on high cost informal lenders has not been researched. It has been suggested that the failure may be due to incomplete understanding of the financial behavior and financial environment of the small farmer. It was found that financial management played a key role in small farm firm's economic growth.

The Agricultural Setting

South Vietnam is predominantly an agricultural country. In 1960, over 80 percent of the labor force was employed in farm, forestry, and

fishery production. A large share of the remaining 20 percent worked in industries concerned with marketing, processing, and transporting agricultural products, or with producing and distributing goods and services used in agricultural production. Agricultural products accounted for over 95 percent of all exports. There is relatively little industrial development and what there is depends heavily upon agricultural raw materials. South Vietnam has few mineral resources. For purpose of this study, South Vietnam is defined to include the following six regions: Delta, East, Lower Coast, Central Coast, North Coast, and Highlands. Wide differences among these regions in climate, soils, and topography influence current land use and future production potentials (Figure 1.1).

Climate

Most of the farming areas have yearly average temperatures of 75°F or higher. Frost does not occur in traditional or potential farming areas. The North Coast and most plateaus of the Highlands have winter temperatures averaging around 68°F, while the higher plateaus and mountain valleys have annual temperatures of between 60° and 70°F. These cool winter temperatures permit production of some cool weather vegetables and other crops, but are believed to adversely affect rice yields, especially in the North Coast.

Rainfall is the primary climatic factor limiting crop production. The monsoons bring excessive rainfall during 4 to 6 months of the year, and extreme drought conditions prevail between monsoons. The summer monsoon dominates the climate of the Delta and East regions, resulting in heavy rainfall (ranging from an average of more than 80 inches in

Figure 1.1 Production-Marketing Regions Used in Production-Distribution Model for South Vietnam

the lower Delta area to less than 60 inches in the upper East area) from about mid-May through mid-November. Rainfall in the Highlands also tends to follow the pattern of the summer monsoon, although it usually begins and ends about a month earlier than in the Delta and East regions. The mountains have some modifying effect in specific areas within the Highlands but rainfall tends to diminish in amount from North to South. May-October rainfall, for example, averages about 92 inches at Pleiku, 63 inches at Banmethout, and 52 inches at Dalat. The Fall monsoon dominates the climate of most of the coastal regions. It normally occurs from late August to mid-January and brings rainfall ranging in average from about 100 inches at Hue to less than 50 inches at Nha Trang.

Rainfall in some areas of the Highland and Coastal regions is obviously influenced by both the Summer and Winter monsoons.

Other climatic factors affecting Vietnamese agriculture are high humidity, overcast conditions during the rainy season, relatively short day length, and occurrence of typhoons in the northern areas.

Soils

The soils of South Vietnam are highly diverse with respect to origin, physical properties, native fertility, and response to technical inputs. The soil profile is relatively deep in most areas of the nation. Vietnam could grow many kinds of fruit trees and industrial plants such as rubber trees, coffee, tea; alluvial soil in the Delta is also appropriate for different varieties of rice and secondary crops. With a fertile soil, Vietnam can undoubtedly diversify and intensify its agriculture as soon as the water control system is strengthened.

The major soil types found in South Vietnam are as follows:

Soil Type	Region	Area (1000 Hectares)
Red soils	throughout the country	2,000
Acid alluvial soils	Dongthapmuoi and Rachgia	618
Less acid alluvial soils	Dongthapmuoi	1,056
Saline alluvial soils	Camau, Rungsat	468
Organic soils	Uminh	143
Gray soils	Eastern South Highlands	1,890
Complex mountainous soils	throughout the country	6,200
Alluvial soils		2,348
Waste and other		2,605
TOTAL		17,328

Topography

The alluvial areas of Vietnam are low-lying and flat. Elevation of most of the Mekong Delta ranges from one to three meters. The slight change in elevation results in sluggish flow in streams crossing the Delta during the dry season and is conducive to flooding during the rainy season. These conditions facilitate capturing rain water for paddy production but make disposal of excess water difficult. Poor drainage would pose a serious problem in the production of secondary crops during the rainy season in much of the area.

Plane topography characterizes a large proportion of the terrace areas. Terrace soils normally occur adjacent to alluvial areas. These areas range from flat to undulating. Consequently land in these areas varies from depressional land which lends itself to paddy production to rough land with excessive drainage.

The upland areas vary from relatively flat to mountainous. There are several plateaus and numerous valleys within the upland region that contain relatively large areas of flat to gently rolling land. Steep hills and mountains occupy a large proportion of the area, even extending to the South China Sea along much of the coast line to form the pockets or plains that make up the Coast region.

Land Use

South Vietnam has a total land area of 17.3 million hectares, about 1 hectare per capita. However, only 2.8 million hectares are cultivated.

Table 1.1 Land Resources of South Vietnam, 1968

Land Use	Hectares
	Thousand
Cultivated land	2,808
Forest land	5,949
Grassland, waste and other	8,571
Total	17,328

Source: Agricultural Economics and Statistics Service, Ministry of Agriculture, Saigon.

Nearly 6 million hectares are classified as forest land but little information is available concerning kinds, quality, and quantity of timber growth on this land. Approximately 8.6 million hectares are classified as grassland, waste, or other land. Much of this land is highly acid, alkaline, or saline and little is known about its suitability for crop production.

South Vietnam has less cultivated land per capita than most other Southeast Asia countries. Hectares per capita of cultivated crop area (cadastral) were as follows in 1962:

South Vietnam	.19
Burma	.28
Thailand	.31
Cambodia	.47
Laos	.61

Land under cultivation could be increased by growing crops that tolerate high levels of acidity or salinity on soils not now in crop use. Also, it would be possible to greatly expand the hectarage of crops grown if water control improvements were carried out to permit increased multiple cropping on land now under cultivation. However, this would require large investments in irrigation, drainage, and flood control.

Total area of crops grown in 1964 was nearly 3.1 million hectares compared with the 2.8 million hectares of cadastral crop area, indicating that nearly 300 thousand hectares were double cropped (Table 1.2). It appears that only 275 to 300 thousand hectares are irrigated. The total area of crops grown was at a record high in 1964, about 275,000 hectares more than in 1968 according to official statistics.

Land in crops is located mainly in the Delta and East areas of the country. The Delta accounted for more than 60 percent of South Vietnam's total crop area and more than 65 percent of the rice area in 1964. Rice occupied over 90 percent of the cropland in the Delta. The Delta also accounted for the major portion of area planted to pineapples, a crop grown primarily on acid alluvial soils. Since coconuts are tolerant of saline conditions, they are grown predominantly in the Delta where there is an abundance of alluvial soil with a salinity problem. The

Table 1.2 Area and Production of Crops, 1964 and 1968, and Average Crop Yields, 1964-68, South Vietnam

Crop	Area		Production		Average Yield per Hectare 1964-1968
	1964	1968	1964	1968	
	------Hectares------		----------Metric Tons---------		
Annual Crops					
Rice	2,556,800	2,393,800	5,185,030	4,366,150	2.0
Corn	37,000	28,780	46,000	31,760	1.2
Sweet Potatoes	48,000	34,520	301,000	234,685	6.5
Manioc	43,000	35,130	288,600	260,190	6.8
Peanuts	35,000	29,680	36,500	32,055	1.1
Soybeans	6,050	7,820	4,000	7,465	.9
Mungo beans	19,510	21,405	12,000	13,360	.6
Pineapple	8,000	4,540	57,000	34,110	7.5
Vegetables	8,770	13,620	107,650	193,055	13.4
Watermelons	4,400	4,510	36,440	46,950	9.6
Sugarcane	33,710	15,265	1,055,190	401,070	30.5
Fiber crops[a]	4,425	1,955	---	---	---
Tobacco	10,275	8,100	7,275	7,620	.9
Other	5,760	3,130			
Total	2,820,700	2,602,255			
Permanent Crops					
Rubber	134,700	105,730	75,200	34,000	.4
Tea	9,650	7,660	5,380	4,770	.6
Coffee	11,110	10,000	3,420	3,000	.3
Coconuts	41,580	29,905	140,875[b]	110,705[b]	3.5[b]
Fruit Trees	34,570	34,340	231,730	221,880	6.2
Bananas	18,140	17,730	236,800	164,065	10.5
Miscellaneous tree crops	6,390	1,765	---	---	---
Total	256,140	205,130			
GRAND TOTAL	3,076,840	2,807,385			

[a] Including Kapok, a tree crop.

[b] Thousand Nuts.

Source: *Agricultural Statistics Yearbook, 1964-1968*, Agricultural Economic and Statistics Service, Republic of Vietnam, Ministry of Agriculture.

Delta also accounted for more than three-fifths of the area in bananas and other tree fruits.

The Delta normally supplies much of the rice consumed in other parts of South Vietnam. This region accounted for 75 percent of the rice produced but for only 37 percent of the population of the country in 1968.

Rice accounted for about 80 percent of the land in cultivated crops in areas outside the Delta. Land in secondary crops was higher in these areas, probably because of availability of lighter terrace and upland soils which are not well suited for growing rice but better adapted for other crops, e.g., peanuts. It is likely that climatic factors also affected the distribution of some secondary crops. The North Coast, for example, is subject to typhoons. Low growing crops such as peanuts and sweet potatoes accounted for a larger proportion of cropland in this area than in other areas.

Rubber, tea, and coffee occupied more than 25 percent of the land in crops in the East area and in the Highlands. These two areas accounted for most of the land devoted to these crops. Production was primarily on upland soils.

Animal Husbandry

Swine and poultry are found throughout the country, but they are most numerous in rice growing areas. The Delta, for example, accounted for 60 percent of the total number of pigs and poultry in 1968 (Table 1.3).

Rice paddy and rice bran apparently account for much of the feed consumed by pigs, chickens, and ducks. There is a close association between numbers of pigs and chickens and rice production by provinces.

Table 1.3 Livestock and Poultry Numbers by Regions, 1968

Kinds of Livestock and Poultry	Delta		Coastal Regions	Highland	Total
	Western Part	Eastern Part			
	Thousands				
Buffaloes	336	116	168	27	647
Cattle	313	108	485	47	954
Horses	1	4	2	3	10
Swine	2,023	480	943	107	3,553
Goats	13	2	11	15	40
Sheep	3	---	---	7	10
Chickens	12,472	3,192	3,955	386	20,500
Ducks	11,929	1,705	1,488	27	15,149

Source: *Agricultural Statistics Yearbook, 1968.* Agricultural Economics and Statistics Service.

Most livestock and poultry production is on farms that also produce rice and other crops. There has been a rapid growth in large-scale specialized swine, broiler, and egg producing farms based on imported feeds, especially around Saigon, since 1968. But these farms still account for a small share of total livestock production.

South Vietnam's imports of milled rice have averaged over 600,000 metric tons annually in the last three years, about one-fourth of the total quantity used for food. Self-sufficiency could be achieved before 1980, especially if a larger share of the paddy produced is milled and used for food. Little is known about disposition of rice paddy, but the share used to feed hogs and poultry probably has increased in the last two years because of high prices for animal products, scarcity of bran and brokens normally used for feed, and larger supplies of low quality rice associated with adoption of high yielding varieties. Prices that farmers receive for the new varieties are often only one-half of those received for traditional varieties.

Much emphasis has been placed on expanding commercial production of hogs, poultry, and eggs in the last few years. Large-scale commercial hog and poultry farms have been highly profitable in some instances, but these farms have been made possible by low-cost feed, breeding stock, veterinary products, other capital inputs, and technical assistance. Efforts now are being made to expand domestic production of corn and grain sorghum. Little is known about yield potentials of feed grains on new land that might be brought under cultivation but yields likely will be less than 1.5 metric tons per hectare.

Labor

The labor force dependent upon agriculture for employment may increase 40 percent by 1980 from natural population growth. Many people who have moved to urban centers may be reluctant to return to rural areas. Large numbers probably will seek jobs as hired farm workers. There is a large potential for employing many workers to improve land and water resources and infrastructure, but ways of financing employment on projects for these purposes will need to be developed.

During the five hot months of the dry season when there is little farm work, the farmer may look for supplementary labor in a larger village center. Generally, his activities are confined to fishing, mending and repairing the dikes and houses and similar work, until the start of the rainy season and new crop planting begins. Each farm family does most of its own work (unpaid family labor). In traditional farming areas, larger farms hire labor for crop production.

Types of Farms

Farming in South Vietnam has consisted of two almost unrelated segments. The two segments have competed hardly at all for land and only to a small degree for other resources.

One universe, involving less than 5,000 farms, includes producers of industrial crops, primarily rubber, tea, and coffee. Most of the production comes from a few large plantations, highly commercial in orientation and largely owned by foreign interests. Production is mainly for export.

The second universe consists of almost two million small farms that produce mainly rice. Most of these farms have small poultry and

swine enterprises and also grow small hectarages of a wide variety of other crops.

Farms in provinces included in South Vietnam's 1960 Census of Agriculture averaged 1.34 hectares in size. Average farm size is larger in the Delta and East regions than in the Coastal region.

About half of the farms in all areas outside the Delta were less than one-half hectare in size. In the Delta about one-third of the farms were over two hectares but only a small proportion in other areas were this large. The bulk of the larger farms in the Delta were located in provinces with serious salt intrusion or flooding problems. Thirteen percent of the farms in the flood rice provinces, for example, had more than five hectares and the average size of farms in these provinces was 2.33 hectares.

Although some areas have been influenced by migration of farm people to urban areas, the total number of farms probably has not changed much since 1960.

Rice is the main crop grown on nearly all small farms in the Delta, East and Coastal regions, but most farms also grow some fruit, vegetables, and other crops, especially for home consumption.

Farm Technology

Production methods on small farms in South Vietnam are typical of those throughout Southeast Asia. Rice land is plowed, harrowed, and puddled using water buffalo or cattle as a power source. Seed is planted in a seed-bed and young plants are transplanted, and on some land transplanted a second time, to the paddy. Weeding is done by hand. The rice is cut, thrashed, winnowed, and cleaned by hand. Numerous estimates of labor requirements exist, ranging from 35 days to 200 days

per hectare. Methods involving high labor inputs tend to be carried over from rice to other crops.

The cultural practices followed in growing rice vary among areas depending upon topography, rainfall, drainage, soils, and other factors. The Delta region is classified into three areas according to planting and cultivation practices: single transplant rice, double transplant rice, and floating rice (Figure 1.2). In the West Subregion of the Delta, which is subject to annual flooding, floating varieties of rice are grown. In this area the fields are flat and have no dikes and the floodwaters have free access to the land. Farmers plow their land any time from February to May depending on the time of the early rains. At the beginning of the rainy season, the rice is broadcast over the plowed fields. The floating varieties of rice have very rapid growth characteristics that enable them to cope with water depth where ordinary varieties cannot survive. These low-yielding varieties generally have poor market quality. The low yield may be due to the fact that farmers do not use fertilizer. The single transplant method of cultivation generally is used in the Coastal Subregion where planting must be postponed until salts accumulated during the dry season are leached out of the soil by rainwater and where water is stagnant early in the growing season. Weeding and maintenance of water levels in rice fields are the most important operations between transplanting and harvesting. In the Central Subregion of the Delta, the fields are so rich in organic matter and nitrogen that farmers double transplant rice seedlings to reduce vegetative growth and to control weeds. In the East area of South Vietnam, the single transplant method of cultivation is used and cultural practices are similar to the Delta region.

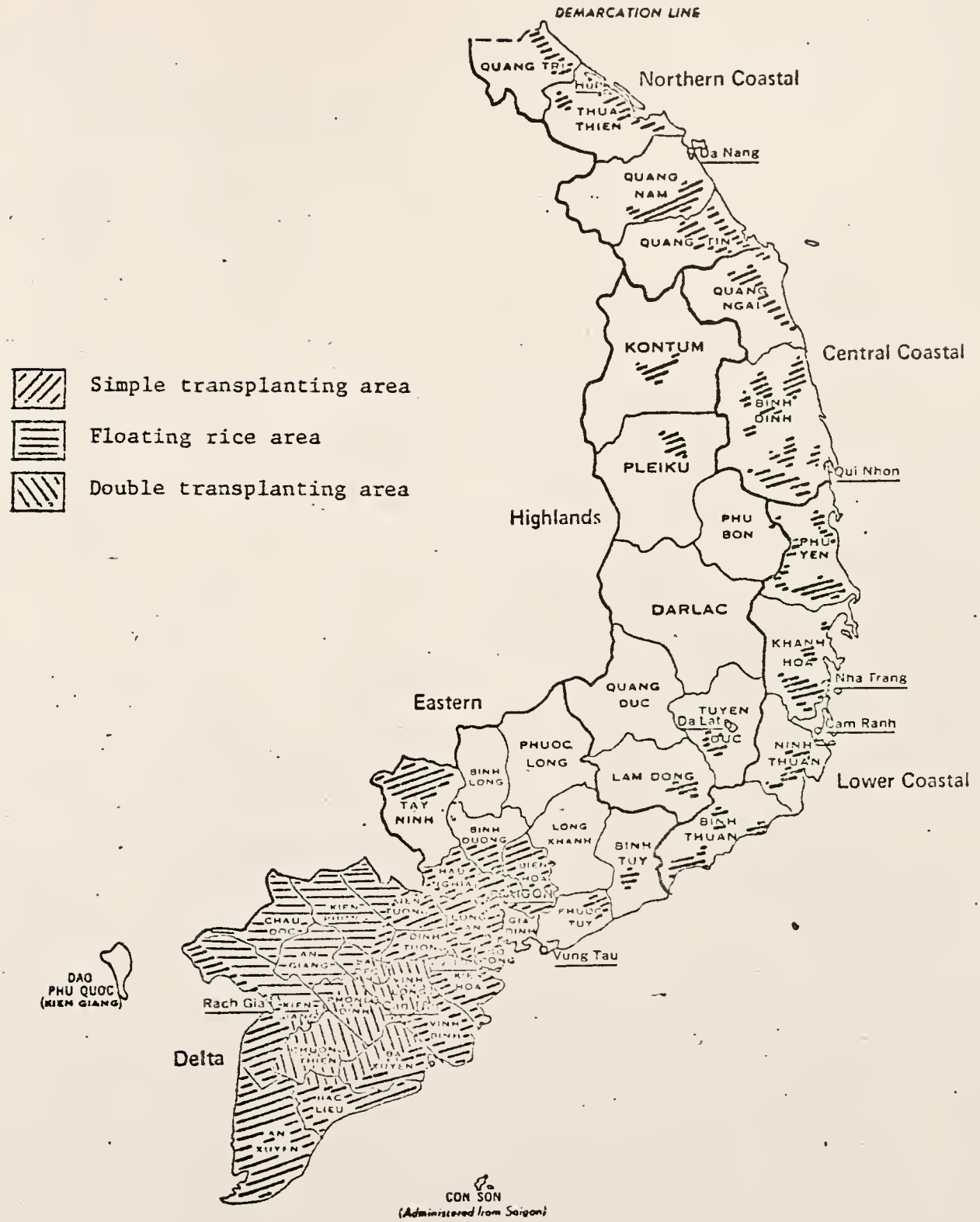

Figure 1.2 Rice Areas of Production

In recent years small two-wheel tractors and the conventional four-wheel farm tractors have been used in increasing numbers. It was estimated that there were more than a thousand of the two-wheel tractors in each of the four crops regions in early 1970. There were believed to be more than a thousand four-wheel tractors in the Delta with lesser numbers in the other areas. These tractors are used for plowing and harrowing and the small tractors are also used for puddling. They are usually owned by the large farmers who work their own land and do custom land preparations for others. The larger tractors are particularly adapted to this kind of utilization in the large unlevied fields in the floating rice area of the Delta.

Rice varieties are generally those that have proved adapted to local conditions. They deliver about the maximum yield that can be expected with a low level of inputs. In the late 1960's, however, improved rice varieties (IR-5 and IR-8) were introduced. These varieties have a great capacity for output response to fertilizer under proper growing conditions. Rapid adoption of these varieties by farmers became a major goal and comprehensive programs were implemented to encourage their production.

Improved varieties were planted to more than 200,000 hectares during the 1969-1970 growing season, with an average yield of 4.7 metric tons per hectare. Recent price-cost relationships, involving a highly inflated rice price and low prices for fertilizer and pesticides under import programs, have created an ideal economic environment for adoption of the new high yielding varieties.

Practically all irrigation was done with buckets or the use of a "water wheel" and undoubtedly the amount and timeliness of water added varied tremendously among farms. Most of the irrigated area was double

cropped in the Coastal region but only about six percent was double cropped in the Delta. The reason for the wide disparity in extent of double cropping on irrigated land between the Delta and the lowlands is not known. It may be that this was related to differences in monsoon seasons and differences in pressure of population on land between the two areas. It is possible that some of the irrigation counted in the Delta was in the form of supplementary water added to the single crop produced in the rainy season.

CHAPTER II
METHOD AND RESEARCH PROCEDURE

Agriculture, the major sector of South Vietnam, contains most of the labor force and households and much of the nation's capital. If national welfare is to be increased materially, important income increases are needed for farm families. The resources of agriculture contribute significantly to economic development. In South Vietnam farm inputs as represented by capital and unpaid family labor are the major farm resources.

Most allocative problems arise because spatial distribution of agriculture is wide; the number of firms in the farm sector greatly exceeds those in industry; the extreme capital limitations of farmers intensify the allocative problem. Linear programming represents the decision framework for the attainment of maximization of net income under a particular environment represented by technology, prices or their distribution, and capital resource limitations.

Linear programming is a computational method to determine the best plan or course of action, when there are many alternatives for the plan, a specific or numerical objective exists for it, and the means or resources available for attaining it are limited. These conditions prevail widely and typically in agriculture. The individual farm always has limited resources or restrictions on production. They come in the form of land in total or several fields each with different soil types, family labor, the funds available for operation, buildings, tractor or

machine capacity, and other physical resources. More specifically, linear programming is the analysis of problems in which a linear function is to be maximized (minimized) when those variables are subject to a number of constraints in the form of linear inequalities. The conditions and assumptions of linear programming have been listed by Agrawal and Heady as linearity of the objective function, divisibility, additivity, and finiteness of resources and activities, nonnegativity of the decision variables, proportionality of activity levels to resources and single-valued expectations [3].

Normative Model

Linear programming is mainly a procedure for providing normative answers to problems. In contrast to normative, the term positive is used in economics to describe analyses which explain phenomena as they exist. By normative we refer to the course of action which ought to be taken by an individual, business unit, area, or other economic sector when the end or objective takes a particular form and the conditions and restraints surrounding the action or choice are of a particular form. Oury and others have discussed advantages and disadvantages of normative models such as linear programming and positivistic models such as least squares for economic planning and analysis [19]. The choice of models is not clear-cut and definitely depends on the nature of the data and objectives of the research.

Firm Theory

An important problem involves the fixity of farm resources, their utilization, their salvage value if any, and how best to combine them

with the variable resources at hand in order to maximize farm income. Increased volume of production lowers per unit costs of production. To measure the return for farm business, net income is the difference between receipts and expenses. Farm income is the return to all factors of production. Net farm income is the source of payments to the farmer's labor, management, land, and capital.

On the national level, net agricultural income is given by an aggregation of net farm incomes. In this study, net agricultural income is defined as gross agricultural income, including the value of rice consumed on farms, less production costs and processing, marketing, and transportation costs.

Net income = gross farm product - production cost
- (processing cost + transportation cost
+ marketing cost) + rice consumption on farm

South Vietnam is defined to include the following six regions—Delta, Easter, Lower Coast, Central Coast; North Coast and Highland. The subscripts for regions, crops and livestock and inputs are as follows:

Six regions:	$i = 1, \ldots, 6$
Crops and Livestock:	$j = 1, \ldots, J$
Inputs:	$k = 1, \ldots, K$

Let P^{y}_{ij} = price of j crop and livestock production of i region.

Y_{ij} = j crop and livestock production quantity of i region.

Crops: banana, rice, coconut, coffee, corn, cotton, jute, kenaf, peanut, pineapple, rubber, soybeans, sugarcane, sorghum, tea, tobacco, wheat.

Livestock: beef, pork, chicken, ducks.

C_{ij} = quantity of consumption of j crop of farm in i region.

P^{x}_{ijk} = K input cost of j crop in i region.

X_{ijk} = quantity of k input of j crop in i region.

Inputs: capital, land, labor, spray , pump, fertilizer, fuel, endrin, malathion, sevin, DDT, methyl malathion, lime, poultry feed, poultry protein supplement, hog concentrate feed, hog protein supplement, tractor, cattle, buffalo.

P^{P}_{ij} = processing cost of j crop in i region.

Q^{P}_{ij} = processing quantity of j crop in i region.

T_{ij} = transportation cost of j crop in i region.

Q^{t}_{ij} = transportation quantity of j crop in i region.

M_{ij} = marketing cost of j crop in i region.

Q^{m}_{ij} = marketing quantity of j crop in i region.

$$\text{Net income} = \sum_i \sum_j (P^{y}_{ij} Y_{ij} + P^{y}_{ij} C_{ij}) - (\sum_k P^{x}_{ijk} X_{ijk} + P^{p}_{ij} Q^{p}_{ij} + T_{ij} Q^{t}_{ij} + M_{ij} Q^{m}_{ij}).$$

Parametric Programming Model

This dissertation focuses on capital needs in agriculture in South Vietnam. It seeks to determine the particular combination of resources that will be employed and evaluations will be made regarding particular capital constraints. Therefore, this study is similar to parametric programming to maximize national agricultural income. Variants of linear programming can include sensitivity or parametric models to test the relation of price weights, technical coefficients, and resource restraints on the selection of optimal plans. Parametric programming is also adapted

to normative problems in planning or choice. Given this end, parametric programming indicates the pattern of resource allocation, the nature of investment which will maximize profit or rate of return and/or maximum net income, and the selection among strategies which will minimize unfavorable outcome from the vagaries of weather or the market. For low-income farmers with little capital, the goal for investment in fertilizer or other inputs can more nearly be the maximum net income or maximum rate of return on investment (e.g. the maximum net income or maximum return per unit of capital), rather than maximum return per unit of land.

Productive capacity of South Vietnam's agriculture was examined in terms of the quantity and mix of agricultural commodities needed to maximize national agricultural income. A linear programming model was tailored to the particular conditions and problems existing in South Vietnam. Production relationships are among resources, enterprises, and regions. The programming model also explicitly reflects processing, marketing, transportation, and consumption phenomena and relationships. The study addresses questions relating to the impact on Vietnam's agricultural economy of the changing capital factor within the historical resource situation. The historical land resource base is defined to include existing land, plus land previously abandoned. It does not attempt to project into the future on the basis of trends of production patterns. Rather, the analysis is in the context of "what if?"—what would be the expected effect of specified changes? Since the analysis employs an optimizing technique, since linear programming implies change, and since it is in a "what if?" context, there obviously are numerous explicit and implicit assumptions (See Appendix) [10].

A supply response analysis normally is concerned with production relationships. An agricultural supply response or production capacity analysis usually stops at the farm gate; marketing systems and price relationships are taken as given. However, conditions in Vietnam dictated special and formal consideration of distribution and price phenomena in conjunction with price relationships. Therefore, it was necessary to expand the scope of the study; this segment of the analysis might properly be identified as a production-distribution analysis. Also, a transportation submodel is included for moving commodities between areas at appropriate costs. A marketing-processing submodel is also included for marketing, necessary processing, and transferring each commodity, at approximate costs, either directly to consumption, to export, or to the transportation system for movement to consumption or export in another region. Consumption requirements of a given region can be satisfied by production within the region, transporting production from another region, or by importing into the country.

Supply response estimates developed for individual farms or land resource situations and aggregated to regional and national levels provide the most effective basis for full economic development planning. Development and use of the supply response estimates involve several steps. Since production possibilities for various enterprises vary from area to area because of differences in soil type, climate, topography and other features, relatively uniform production regions or situations must be delineated. For each production region, measures of physical inputs and outputs must be developed for each enterprise. Prices must then be applied to these inputs and outputs to determine the most profitable enterprises for production in each region or land

resource situation, taking into account the supplementary or competitive nature of each enterprise and availability of resources. Also, several steps are involved in setting up and interpreting a linear programming model. The production possibilities, income, and criterion equations, with some modifications, form the core of the simplex method used in solving linear programming problems. First, a feasible program is selected. A feasible program is one consistent with the given resources. The next step is to compute net income under the initial feasible plan by using the net income equation. Then the criterion equation is applied to find out how the increase or decrease in some activity affects income. In the simplex procedure, a whole set of activities representing a feasible plan is compared to another set, rather than comparing a single activity against another activity. The income-increasing activity is increased and again the change in income is found. The entire procedure is repeated until the criterion equation indicates that the optimum has been reached.

The most efficient and effective methods of organizing the above steps into a formal planning technique is through the use of a linear programming analysis. However, the more complex model would permit determination of the commodity mix for the resource situation for regions as well as the nation as a whole. Simultaneously, regional outputs could be determined for use in estimating market facility requirements. National outputs, incomes, foreign exchange impacts, and capital requirements likewise could be generated. Capital, labor, management, and foreign exchange data will also be required to provide the required marketing support. The requirement for marketing facilities will be largely determined by the optimum mix, quantity, and location of production.

Total income is defined to include farm income and consumers' surplus. The total figure represents the level of net agricultural income (gross agricultural income, including the value of rice consumed on farms, less production costs and processing marketing, and transportation margins) that would be associated with each solution if all farm products were in a deficit supply position, i.e., all gross commodity values would be based on import price levels. The farm income figure represents the actual net agricultural income associated with the particular solution. It reflects the actual level (export or import) of price for each commodity, based on whether it is in a deficit or surplus supply position in the solution. The difference between total and farm income is called consumers' surplus. It represents the monetary advantage accruing to consumers from lower prices on those commodities with production in excess of domestic consumption requirements, i.e., consumption expenditures for commodities being exported are reduced by amounts reflecting the difference between their import and export prices [10].

Mathematical Linear Programming Model

Programming problems are concerned with the efficient use of allocation of limited resources to meet desired objectives. A linear programming problem differs from the general variety in that a mathematical model or description of the problem can be stated, using relationships which are called "straight line" or linear.

The complete mathematical statement of a linear programming problem includes a set of simultaneous linear equations which represent the conditions of the problem and a linear function which expresses the objective of the problem.

The maximization of the objective function is subject to certain linear constraints. In the matrix form:

$$\text{maximize } Z = c'y$$

$$\text{subject to } Ay \leq B$$

$$y \geq 0$$

where c is a vector of prices or other weights for the objective function,

y is a vector of activities or commodities to produce,

A is a matrix of input-output coefficients,

B is a vector of resource or other constraints,

$Z = c'y$ is the objective function.

Let b_k = K^{th} amount of resource available,

a_{ijk} = the amount of resource k used to produce one unit of product j in the i^{th} region.

Maximum income, as described in this study, can be transformed into a standard linear programming form.

$$\text{Maximum income} = \sum_i \sum_j (P^y_{ij} Y_{ij} + P^y_{ij} C_{ij}) - (\sum_k P^x_{ijk} X_{ijk} + P^p_{ij} Q^p_{ij} + T_{ij} Q^t_{ij} + M_{ij} Q^m_{ij})$$

subject to the linear structural constraints.

$$a^i_{11} Y_1 + a^i_{21} Y_2 + - - - - - - - - - - - - - - + a^i_{J1} Y_J \leq b_1$$

$$a^i_{12} Y_1 + a^i_{22} Y_2 + - - - - - - - - - - - - - - + a^i_{J2} Y_J \leq b_2$$

$$\vdots \qquad \vdots \qquad\qquad\qquad\qquad\qquad\qquad \vdots \quad \vdots$$

$$a^i_{1K} Y_1 + a^i_{2K} Y_2 + - - - - - - - - - - - - - - + a^i_{JK} Y_J \leq b_K$$

for the i^{th} region and the non-negativity constraints:

$$Y_1 \geq 0,\ Y_2 \geq 0,\ - - - - - - - - - - - - - - -,\ Y_J \geq 0.$$

The number of activities (3933) and constraints (1705) was used in the application of this model.

CHAPTER III
INSTITUTIONAL SYSTEM OF CAPITAL AND CREDIT SUPPLY

Agricultural Credit and Cooperatives

The National Agricultural Credit office (NACO) was officially created by presidential decree in April 1957. Its initial capital consisted of assets transferred from already existing agricultural credit agencies. Prior to the establishment of the National Agriculture Credit office, there was duplication of effort, scattered administration, and lack of trained personnel, and generally ineffective services. The newly formed credit office was capitalized at 850 million piasters, of which 330 million piasters were provided by the national budget and the remainder allocated from United States aid funds. By 1965 its capitalization had been increased to 895 million piasters. The major policies of NACO were to grant small loans to farmers without collateral and to extend credit to cooperatives.

Agricultural cooperatives existed during the colonial period, but since they were primarily for the purpose of facilitating the export of agricultural products, they were of little benefit to the Vietnamese farmer. Regulations established in 1954 governing cooperatives imposed such complex procedures that no effective leadership or organization was developed. Various rice-milling, fishing, tobacco, charcoal and forestry cooperatives were in operation before this time, but these had little support and only a precarious financial standing because of insufficient capital and bad debts.

In 1959 the committee for Cooperation and Agricultural Credit was created by presidential decree to coordinate and provide general direction in the area of farm credit and cooperatives without undue interference in the internal affairs of local organizations. In June 1960 there were reported to be 266 cooperatives with a total membership of 96,810 and a paid-in capital of 27,660,807 piasters. There were 40 rice cooperatives, 80 farm cooperatives of other types, 3 forestry cooperatives, 2 livestock cooperatives, 76 fishery cooperatives, 57 handicraft cooperatives, 6 consumer cooperatives, and 2 others. The Commissariat was abolished in 1965, and the Directorate of Cooperatives which succeeded it reported 333 local cooperatives with 130,154 members and 6 unions of cooperatives consisting of 154 local cooperatives and farmers' associations.

Farmers' associations (Hiep-Hoi Nong-Dan) were also authorized by presidential decree in 1958 and were, in part, designed to supplement cooperative organizations. Established with the assistance of Chinese Nationalist technicians of the Joint Commission for Rural Reconstruction from Taiwan, the associations were organized on village, district, provincial and national levels. In 1965 membership was reported to be 284,130 persons.

The National Agricultural Credit office has been established by the government to serve credit needs which the private banks have been reluctant or unable to meet. The National Agricultural Credit office was created as an autonomous public institution. It took over the assets and liabilities of certain other agencies, principally the Popular Agricultural Credit and the National Company for Agricultural Credit, Artisans and Cooperatives. By the end of December 1964 it had one interprovincial

agency, 40 provincial agencies, 17 interdistrict agencies and 34 agencies at the district level. The National Agricultural Credit office is capitalized at 895 million piasters, of which 628 million piasters were allocated from United States aid funds, the remainder from the national budget.

The National Agricultural Credit office grants small loans to farmers. Short-term loans for annual crop production are from 6 to 18 months, medium-term loans from 18 months to 5 years and long-term loans from 5 to 15 years for capital invested by cooperatives, plantation owners and well-established farmers. Interest rates charged are 1 percent per month for short-term loans, 8 percent per year for medium-term loans and 6 percent per year for long-term loans. Legally established cooperatives are charged 5 percent per year, and farmers' associations at district level are charged 9 percent. By the end of December 1964 the National Agricultural Credit office loans had totaled 4,976.6 million piasters, of which 4,235.7 million had been short-term loans to farmers. Aid to rubber planters, a project also controlled by the National Agricultural Credit office but terminated in 1961, amounted to 315.8 million piasters loaned to 26 Vietnamese and 10 French planters.

In June 1964 the Pacification Fund was created within the National Agricultural Credit office with a capital of 300 million piasters granted from the National budget. Loans under this program were intended to support animal husbandry, fisheries, and the use of fertilizer. On December 18, 1964, 92 million piasters were withdrawn from this fund to establish a special fund exclusively for the relief of flood victims in 12 provinces in the Highland and Coastal Regions. Loans from the Pacification Fund were issued under simplified procedures, and loans in kind for chemical fertilizers were free of interest. Under the flood-relief

program, farmers and fisherman were specially stated to be eligible and loans also bore no interest. At the end of 1964, Pacification Fund loans amounted to 117.1 million piasters.

Other Credit Institutions

There are 23 commercial banks in Vietnam, 10 local and 13 foreign. Generally speaking, the commercial banks are interested only in loans to plantations. They prefer to concentrate their activities in the urban centers and have been reluctant to extend their services into rural areas. They have not provided funds for producer organizations such as cooperatives and other associations. Thus, the commercial banks have done only a very limited job of providing agricultural credit.

Dealers and merchants have provided a large part of the credit used by Vietnamese farmers and fisherman. In many cases, this credit has consisted of loans in kind and usually carry a very high interest rate. Credit extended by dealers and merchants is highly personalized and involves an absolute minimum of formalities. In the legal sense, the loans are largely unsecured.

Relatives, friends, and neighbors also provide agricultural credit. These personal loans are usually for small amounts and for short term but in the aggregate they are important. Studies indicate that over half of the loans from this source are interest free. Such loans will undoubtedly continue to be important but will decline in importance as the agriculture of South Vietnam becomes more commercialized.

There are a number of other credit institutions in South Vietnam outside of the formal banking system. In December 1955 the government abolished all private pawnshops, which charged very high rates of interest,

and replaced them with a greatly expanded system of pawnshops of its own.

The major source of credit in terms of number of borrowers, however, remains the private moneylenders. People continue to turn to the moneylender, notwithstanding his often usurious charges, both because he is a familiar figure and because his services can be had without the red tape connected with the government institutions.

Mutual aid societies are also of some importance. The most common type is the Giap, a term once applied to an administrative subdivision of the village but now signifying an association of men or women who have banded together for financial self-help. The organization's funds and other assets come from the contributions and bequests of its members. In addition to its insurance and benevolent functions, the giap is a vehicle for ceremonial and social activity.

Another type of association, the ho ("Family" and, by extension, "cooperation" or "mutual association"), is often formed by women and combines speculation with mutual assistance. There are various types of ho. The ho hieu, or filial piety associations, are somewhat like burial insurance societies in the United States. Other ho help the peasant with the purchase of seed and agricultural implements.

Another form of mutual aid society is the bang of the Chinese community. A charitable and mutual aid association for its established members, the bang also provides the newly arrived Chinese with food and shelter until he finds employment, lends him money and gives him advice. The Vietnamese authorities have found it a convenient channel through which to deal with local Chinese groups.

Agricultural Development Bank of Vietnam

The government has long been conscious of the need for additional rural credit facilities, so in 1957 it founded the National Agricultural Credit Organization (NACO). But NACO suffered from inadequate capital, traditional banking methods, and a lack of trained personnel. It was terminated in April 1967. The Agricultural Development Bank of Vietnam (ADBV) was formed the following month with an initial capitalization of 200 million piasters. The ADBV was assigned the two-fold task of promoting agricultural development and financing farm rehabilitation. It was recognized that the exigencies of war would require unusual flexibility in loan policies and operating methods, flexibility NACO had not had.

Organization

The Agricultural Development Bank of Vietnam (ADBV) was established in 1967 with a capital of VN $200,000,000 totally subscribed by the government. It assumed the assets and liabilities of the National Agricultural Credit Office (NACO), a predecessor credit agency which no longer exists. The ADBV charter provides for lending operations in the fields of agriculture, forestry, fisheries, and agriculturally related business enterprises.

The ADBV is administered by a Board of Directors composed of a Chairman and six members. The Minister of Agriculture (Land Reform, Agriculture and Fishery development) is the Chairman of the Board. General administrative and operational matters are entrusted to a Director-General appointed by the Prime Minister.

The ADBV has a staff of about 850. It has 43 branches and non-branch offices to cover credit operations in 44 provinces. Generally,

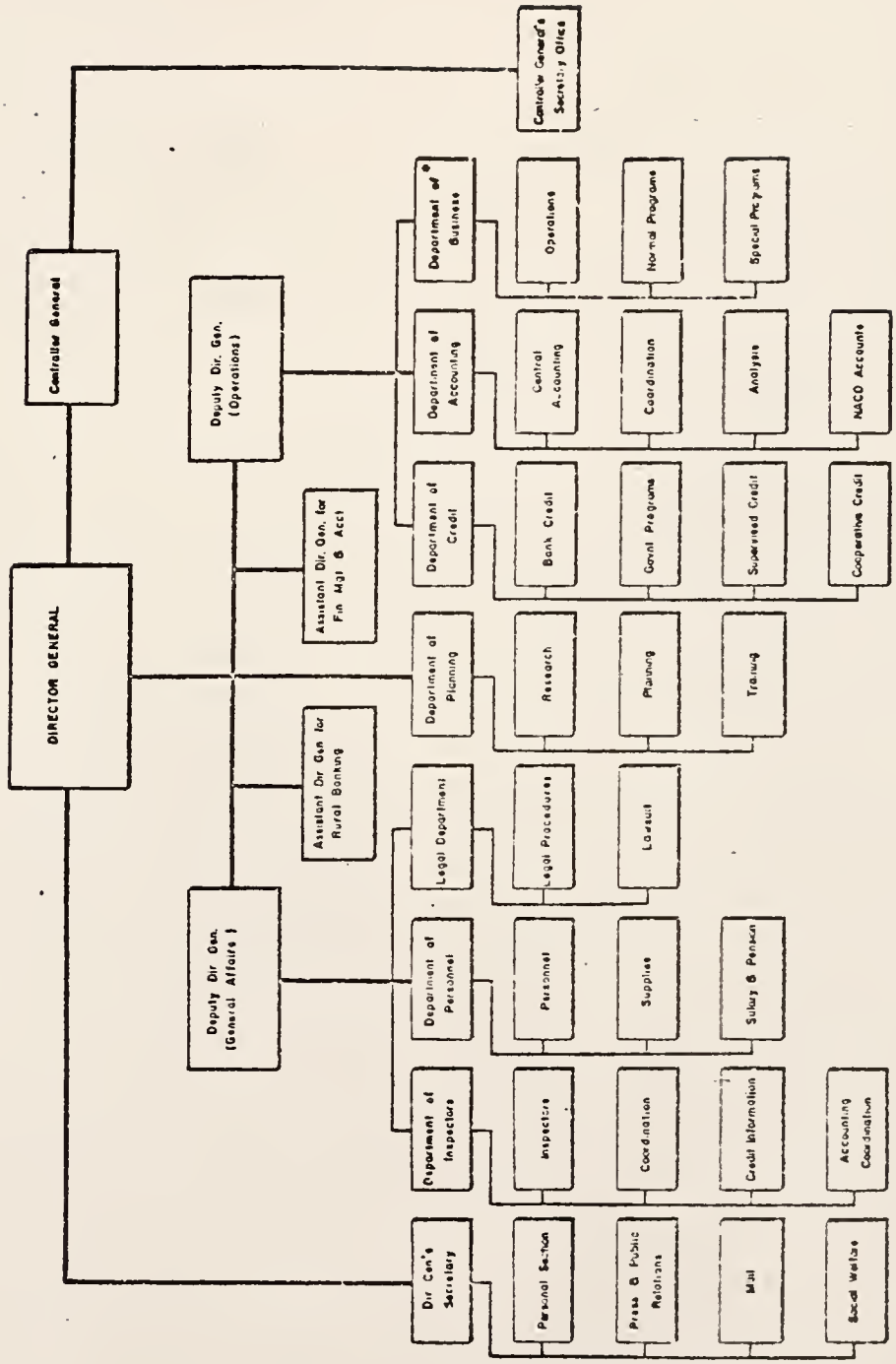

Figure 3.1 Agricultural Development Bank Organization Chart

there is one office in each province but there are two provinces with two branches in each and two with none at all. Twenty-five branches carry out normal banking practices (i.e., savings and time deposits) in addition to lending operations. Ten sub-branches have lower loan approval limits but otherwise operate in the same manner. The eight sub-branches, located in less secure areas, carry out lending operations but do not accept deposits.

When issuing loans for the production of swine, poultry and rice, ADBV generally enlists the services of the Ministry of Land Reform, Agriculture and Fishery Development (MLRAFD) technical staff. In line with this practice, expatriate fisheries experts employed under a project financed by the Asian Development Bank are located in the MLRAFD.

Source of Funds and Financial Position

Apart from the utilization of its own capital, reserves and savings deposits, the ADBV conducts its activities with special program funds provided by the GVN directly, US/GVN counterpart funds and a West German loan to the GVN. Additionally, it has been assigned responsibility for the execution of the Fisheries Development Project for which a loan of US $2.5 million equivalent has just been made available by the Asian Development Bank. The summarized balance sheets in Table 3.1 show, by broad source, the funds employed the last four years. The ADBV has no rediscount facilities with the Central Bank.

Special program funds made available to the ADBV have been split between 18 different accounts operated independently by each other (Table 3.2). Some accounts utilize counterpart funds received on a temporary credit basis, while others involve funds received as long-term

Table 3.1 Balance Sheet, Agricultural Development Bank of Vietnam (ADBV)

Item	1967	1968	1969	1970
	----------VN$'000----------			
Assets				
Cash on hand and due from treasury and local banks	903,791	453,848	684,829	1,082,350
Due from National Bank	356,890	12,892	49,542	263,539
Checks and notes receivable	21,161	85,406	17,146	2,810
Land reform bonds	370	281	199	109
Unreimbursed expense fertilizer program		73,167	58,957	67,855
Loans (less: provision for bad debts)	1,732,458	2,449,633	3,705,122	5,392,985
Other assets	178,640	332,444	597,708	809,525
NACO's assets (less: depreciation)	268,378	162,174	131,595	150,579
Fixed assets (less: depreciation)	33,515	41,442	106,650	169,905
	3,501,203	3,611,288	5,351,748	7,939,657
Liabilities				
Demand deposits	54,346	182,782	290,761	255,015
Checks outstanding	---	45,374	213,259	225,490
Reserves for taxes	---	4,148	4,148	4,148
Reserves for employee pension fund	---	23,472	34,201	43,941
Deposits for special programs expense	1,361,450	69,757	70,327	76,891
Savings, term and special deposits	15,094	104,623	218,100	357,415
Special program funds	1,167,733	2,080,273	3,555,952	5,867,013
NACO's liabilities	492,976	418,379	410,231	159,464
Other liabilities	113,195	304,043	151,426	366,910
Equity				
Capital stock	200,000	200,000	200,000	200,000
Capital surplus and special reserve		30,000	73,532	166,726
Reserve for modernzation	28,358	60,358	96,105	40,417
Net profits (Unappropriated)	68,051	88,079	33,705	176,226
	3,501,203	3,611,288	5,351,748	7,939,656

Table 3.2 Budget Allocated to the ADBV for Various Loan Purposes (as of December 31, 1970)

Item	Amount Allocated (Budget Provision)	Amount Transferred (to ADBV) (Actually Released)	Outstanding Loans
	VN$		
Production and Agri-Business Fund (Fund No. 1)			
Rubber Production Fund	328,871,378	328,871,378	302,623,786
Swine and Poultry Dev. Fund	340,000,000	445,000,000	497,667,705
1969 Supervised Credit Fund	150,000,000	200,000,000	196,850,683
Farm Mechanization Fund	400,000,000	400,000,000	364,526,131
Fish Production	150,000,000	250,000,000	298,607,137
Fund for New Borrowers	1,675,000,000	550,000,000	616,348,121
Farm Organization Dev. Fund	300,000,000	200,000,000	204,080,373
Land Reform Support Fund	600,000,000	150,000,000	117,240,885
Supervised Credit and Pump Fund	132,020,120	132,020,120	963,554,958
Rice Production Fund	201,660,000	651,660,000	96,071,378
Agr. Business Credit Fund	1,000,000,000	1,000,000,000	589,129,048
German Loan Funds	164,888,900	129,555,575	125,810,379
Rural Reconstruction Fund	396,588,297	396,551,949	319,524,344
Seed Fund for Flood Areas	14,065,985	13,954,192	12,879,540
Housing Reconstruction for Flood Areas	48,349,500	48,009,036	45,360,700
1962 Babs Typhoon Fund	2,998,600	2,998,600	2,352,600
Windmill Development Fund	1,290,600	1,326,600	63,400
Rural Development	413,000,000	413,000,000	1,355,000
Sub-Total	6,318,733,380	5,312,947,450	4,754,046,168
Rural Bank Development Fund (Fund No. 2)	300,000,000	163,965,336	41,893,300
GRAND TOTAL	6,618,733,380	5,476,912,786	4,795,939,468

loans from various government Ministries. The counterpart funds have been limited by the conditions of individual project agreements which often require the repayment of funds after a specified period of time. Different interest rates apply to different funds and interchange between funds and unused balances have not been permitted. The restirctions imposed on the ADBV by these varied arrangements led to the establishment in late 1969 of a joint GVN/USAID Credit Committee to review funding programs and future ADBV credit requirements. The main recommendations of this committee were that: (a) the 18 service and special purpose funds be consolidated into one fund; (b) all GVN counterpart funds be contributed to the ADBV as untied working capital; (c) the ADBV be allowed to accept deposits from all sources instead of being limited to the deposits of only farmers and fisherman; and (d) the ADBV should develop a discount and rediscount procedure with the Central Bank. These recommendations have been adopted and were put into effect in 1971.

Total deposits of the ADBV are low compared with total assets. For the year ending December 1970, total demand and time deposits amounted to above VN $600 million as against total assets of VN $7.9 billion (Table 3.1). This reflects several factors: the high rate of inflation, the inability of the ADBV to compete for deposits from industrial and commercial enterprises and the 3.5 percent per annum ceiling on interest rates payable to depositors which existed until October 1970. Rates now stand at 10 percent for savings and from 11 percent to 20 percent for time deposits from one month to one year duration. It is expected that these will attract additional deposit funds for the ADBV's lending activities.

The net profits of the ADBV have increased from VN $34 million in 1969 to VN $176 million in 1970 (Table 3.3) as a result of its administration of an expanded amount of special program funds (Table 3.1). Loan repayments, considering both the war and the nature of some of the special programs undertaken, are reasonably good if NACO's outstanding delinquencies are excluded from the calculations. In this case, repayments stand at 87.2 percent of the total loans due with 8.11 percent overdue 12 months or less (Table 3.4).

ADBV Lending Programs

Apart from the ADBV's own Bank Credit Program, there are 11 other active lending programs currently being implemented by the ADBV and financed by special program funds. These are the West German Loan Program, the Agri-Business Credit Program, the Swine and Poultry Development Program, the Farm Organization Development Program, the Farm Mechanization Program, the Fishery Production Program, the new Borrower Program, the Land Reform Support Program, the Rural Reconstruction Credit Program, the Rice Production Program, and the Supervised Credit Program. The remaining programs specified in Table 3.2 no longer operate.

The ADBV's activities can be divided into (a) its own lending program in which short-term and long-term loans are issued against collateral to private individuals, tenant farmers, farmers' associations, cooperatives, and other legal entities; and (b) the administration of various projects supported by special government funding programs and foreign assistance. According to this scheme of operation, government's capital is theoretically applied to loans for the weaker class of borrowers who do not possess collateral while the ADBV's capital is used to issue

Table 3.3 Income Statement, Agricultural Development Bank of Vietnam (ADBV)

Item	1967	1968	1969	1970
	----------VN$'000----------			
Income				
Interest and commisions on bank loans	54,044	124,841	107,409	91,634
Interest and commissions on special program loans	18,811	78,922	150,513	334,518
Other charges	23,496	9,052	16,616	21,650
Income from supply program	77,864	36,288	8,381	1,838
Income attributable to previous years	8,106	---	---	---
Exceptional profit	---	---	---	---
Total Income	182,321	249,103	282,919	455,641
Expenses				
Personnel	87,093	116,731	137,471	185,973
Rent	10,526	8,650	10,267	16,173
Interests and commissions paid	6,486	10,184	16,041	24,799
Administration	7,509	6,071	11,442	22,600
Depreciations	2,656	3,748	9,611	10,606
Reserve for bad debts	---	14,500	61,000	16,382
Expenses attributable to previous years	---	372	3,383	2,882
Exceptional loss	---	768	---	---
Total expenses	114,270	161,024	249,214	279,415
Net Profits				
(A - B)	68,051	88,079	33,705	176,226

Table 3.4 Analysis of Loans Past Due, December 31, 1970

Item	Loans Repaid			Loans Overdue		Past Due by Age							
						1967		1968		1969		1970	
	VN$'000	VN$'000	%	VN$'000	%	VN$'000	%	VN$'000	%	VN$'000	%	VN$'000	%
ADBV Programs													
Bank Credit Program	1,166,434	1,019,575	87.50	146,859	12.50	1,657	0.14	19,026	1.63	46,478	3.98	79,698	6.75
German Loan Program	153,561	113,287	73.80	40,274	26.20			625	0.39	11,284	7.34	28,365	18.47
Agri-Business Credit Program	2,140,243	2,033,447	95.00	106,796	5.00	26,905	1.25	1,796	0.08	17,761	0.82	60,334	2.85
Supervised Credit Program	209,555	185,429	88.50	24,125	11.50	459	0.21	2,714	1.29	5,132	2.44	15,821	7.56
Farm Mechanization Program	304,299	260,904	85.80	43,395	14.20	---	---	---	---	555	1.18	42,840	14.02
Fishery Production Program	209,150	190,384	91.00	18,766	9.00	---	---	---	---	1,924	0.95	16,842	8.05
Rural Reconstruction Credit Program	264,218	173,227	65.60	90,991	34.40	436	0.16	20,618	7.80	38,819	14.69	31,118	11.75
Swine and Poultry Development Program	393,714	328,363	83.40	65,351	16.60	48	---	5,703	1.48	19,253	4.88	40,348	10.24
Rice Production Program	433,382	290,959	67.15	142,423	32.85	---	---	4,488	1.03	43,291	10.00	94,644	21.82
Sorghum Program	510	270	53.00	240	47.00	---	---	---	---	---	---	240	47.00
Land Reform Support Program	24,976	21,746	87.00	3,232	13.00	---	---	---	---	---	---	3,232	13.00
Farmers' Capitalization Program	350,614	298,941	85.30	51,673	14.70	---	---	---	---	25	---	51,648	14.70
Farm Organization Development Program	54,710	54,653	99.90	57	0.10	---	---	---	---	---	---	57	0.10
Rural Banking Program	11,917	11,917	100.00	---	---	---	---	---	---	---	---	---	---
1962 Babs Typhoon Fund	10	10	100.00										
Sub-Total	5,717,294	4,983,114	87.20	734,182	12.80	29,505	0.51	54,970	0.96	184,522	3.22	465,187	9.11
NACO Programs													
(i.e. pre 1967)	985,223	36,058	3.70	949,167	96.30	851,954	86.45	56,646	5.74	25,149	2.55	15,417	1.56
TOTAL	6,702,517	5,019,172	75.00	1,683,349	25.00	881,459	13.05	111,616	1.66	209,671	3.12	480,604	7.17

loans to those enterprises which can provide the necessary guarantees. However, in practice, this distinction is not preserved. Loans made under some government programs have been issued against hard collateral and charged to the credit funds provided by the GVN budget and the Foreign Aid Budget. Similarly, part of the ADBV's own capital has covered loans to some of the poorest unsecured borrowers because, in the past, they have proved credit worthy. Performance has not suffered as a result; the repayment record of the Bank Credit Program (87.50 percent) is almost exactly the same as the repayments of all the programs administered by the ADBV (87.20 percent) (Table 3.1).

ADBV has a special category of "soft" loans to farmers newly receiving property under the 1956 or the 1970 land reform laws. Farmers may pledge future crops as collateral, receiving cash or equipment in kind with which to level and develop marginal land, hire laborers to help build more dikes for the transition from one-crop to two-crop rice farming, or to buy seed, fertilizer, water pumps, sprayers and insecticides. These piasters are used for special-project or "soft" loans in which a borrowing farmer's main collateral is the soundness of his idea, his competence as a farmer, and his willingness to work to repay his debt. In 1969 the ADBV had these special production credit categories:

1. The Agricultural Production Credit Fund, designed primarily for the promotion of miracle rice strains. Under this program the ADBV loaned 278.7 million piasters in 1969 compared with 83.5 million in 1968.

2. The Agri-business Credit Fund, which provides for the importation of essential agricultural products and their distribution by farm groups and private dealers. The ADBV loaned 1,900 million piasters from this revolving fund in 1969.

3. The swine and poultry production fund, which loaned 337.9 million piasters to almost 7,000 families in 1969 for animal purchase and livestock developments.

4. The supervised credit program, which administers loans to farmers who wish to improve their farms or grow secondary crops. More than 5,000 families received 176 million piasters under this program in 1969. No collateral is required, but the farmer is closely supervised by Vietnamese agricultural extension personnel in all steps from land preparaton through planting and harvesting to marketing. Some of the projects provide for loans in kind--tools, seed, fertilizer, insecticide, sprayers--rather than cash.

5. The pump program, which provides water pumps to farmers who wish to irrigate their fields to grow secondary crops in the dry season. Through this fund 190 families received 1.9 million piasters in 1969.

6. The mechanization of agriculture and fisheries fund, a new program begun in 1969 to enable farmers and fisherman to purchase tractors, boat motors, and other mechanical aids. Loans totaled 246.5 million piasters last year.

Since its inception the ADBV has extended short, medium, and long term loans, with or without collateral, to private individuals, tenant organizations, farmer associations and cooperatives. The government has entrusted funds to the ADBV for special programs to help small farmers. These include agricultural mechanization, poultry and hog raising, miracle rice, rural development credit, and land reform support projects. These loans are made according to criteria not usually accepted by commercial banks--a farmer's good reputation may serve as collateral. But the bank's own capital, which includes people's savings and other deposits, is used for loans to agricultural business and commercial farmers; these loans usually are made according to traditional banking methods.

Farmers who need irrigation and other farm equipment, are offered a low-interest loan by the Agricultural Development Bank of Vietnam (ADBV). The loans, which have a 20,000 piaster (US $169.00) limit, have greatly increased since the IR-8 miracle rice variety was introduced.

In 1966, 28,000 loans were granted totaling 350 million piasters (US $2,966,000). In 1967, the number of loans increased almost three-fold to 83,000 with a total value of 1,750.0 million piasters (US $14.8 million). And in the first five months of 1968 alone, the total amount loaned was 72 percent of the total 1967 figure, or 1,305 million piasters (US $11.1 million).

No ADBV loans are made in cash. Instead, farmers are given cards which entitle them to certain amounts of equipment. A farmer receives rice seeds with a green card, insecticide with a yellow card and fertilizer with a pink card. This system guarantees that the loan will be applied to rice production only. The rate of repayment is rapidly increasing; from 90 percent to 98 percent of the loans are now repaid on time.

The ADBV has supported poultry raising with two types of loans. One is a regular commercial "hard" loan where 60 percent collateral must be produced as security. But "soft" loans are made to refugees and small raisers without collateral. These loans are supervised--specialists' training from planting to marketing goes with them--to make sure the bank's investment program has been successful and almost 100 percent of the loans have been repaid. The bank now will lend to widows, something which it was loathed to do at the start of the supervised credit program.

There is no traditional source of credit for cattle owners; however, beef producers have been provided some credit through Central Pacification Development Councils set up in each province under a program named Village Self Development. These credits are approved and supervised by mutually agreed and village appointed committees and are usually for community development projects.

Total loans covering all activities of the Agricultural Development Bank of Vietnam since 1967 are as follows:

1967 - VN $1.756 billion

1968 - VN $4.642 billion

1969 - VN $4.614 billion

1970 - VN $6.716 billion

Included in the 1970 figure is VN $1,012 million Bank Credit Programs loans and VN $5,704 million Special Programs Loans. Reflecting this, 1970 income in connection with Special Programs Loans was VN $334 million (Table 3.3), approximating the total loans between agri-business loans and production loans split into two equal amounts. Table 3.5 contains a more precise classification. Of the loans issued for livestock production, virtually none has been for long-term cattle production.

Nearly all loans issued (92 percent) have been short-term (less than 18 months, on average probably 9-12 months), while a few (5 percent) have been on medium-term (less than three years) and even fewer (three percent) on long-term. Short-term loans are usually made available at 18 percent per annum interest while medium- and long-term loans attract an interest rate of 14 percent. These rates have been in effect since September, 1970 (prior to that, medium- and long-term rates were 12 percent and 8 percent, respectively). These rates apply to all of the Bank's Credit Program Loans and some of the Special Program Loans. Other Special Program Loans are issued on soft terms.

During 1969 the ADBV loaned a total of 4,613,988,766 piasters to Vietnamese farmers and farm organizations. In 1969, crop production loans accounted for 68 percent of the total. More than 1,300 farmers borrowed 22.5 million piasters for improvement of real estate granted

Table 3.5 Loan Classification According to Use

Item	1968		1969		1970	
	VN$ Mil	%	VN$ Mil	%	VN$ Mil	%
Crop Production	3,513	76	3,148	68	4,793	71
Livestock Production	572	12	666	14	855	13
Marketing Farm Products	272	6	300	7	367	6
Fishing	150	3	373	8	568	8
Other	134	3	124	3	133	2
Total	4,641	100	4,611	100	6,716	100
(Agri-Business	2,095	45	1,892	41	2,339	35)

under the 1956 land reform legislation. The 1969 loans included:

--Crop production loans of 3,145 million piasters or 68.16 percent of total loans;

--Animal production, 661.7 million piasters, or 14.33 percent;

--Fisheries, 384.6 million piasters, or 8.36 piaster, or 6.11 percent;

--Handicrafts, 127.8 million piasters, or 2.77 percent;

--Miscellaneous (including salt and forestry, 13.0 million piasters, or 0.27 percent).

Of the total, 1,417.6 million piasters were borrowed by farm organizations--the National Federation of Agricultural Cooperatives, the Central Farmers Association, the CVT Tenant Farmers Union, and provincial cooperatives. The remainder was borrowed directly by individual farmers--89,405 farmers in 1969 compared with 69,662 in 1968.

The increased number of loans to farmers is one of the bank's most significant achievements in 1969. As security increases, more farmers can be served. The small farmers have to be served even though it is difficult to appraise their credit needs and such loans require a lot of manpower for supervision.

Loan sizes have varied over a wide range, but in order to maximize the number of loans issued, the ADBV has been forced to specialize in lending both short (term) and small (amounts). In 1969, approximately 90,000 separate loans were approved and disbursed. More than 90 percent were for amounts under VN $50,000 (60 percent were for amounts less than VN $20,000). Of the 90,000 loans, about 60 percent were unsecured and 40 percent secured by real estate or chattel mortgage. The majority of loans were issued to Vietnamese citizens as distinct from ethnic minority groups. Loans to Montagnards would probably have been no more than 1 percent of the total loans issued.

Lending Procedures

Borrowers submit loan applications to the ADBV branch offices which are authorized to approve loans of up to VN $500,000 against real estate or other fixed asset collateral and loans of up to VN $300,000 if the security offered involves movable assets. Loan applications exceeding VN $500,000 are referred to the Saigon main office for consideration and to the Director General for approval. The Director General is authorized to approve loans of any size if security involves a mortgage of fixed assets but is limited to loan sizes of VN $5,000,000 if collateral relates to movable assets. Loan amounts over these limits must be submitted to the Board of Directors for approval.

In an effort to reach a greater number of farm families, the ADBV has started several programs, including:

1. "Master borrower" loans. These involve an informal group arrangement. Ten or more farmers join in selecting a leader who negotiates a loan with the ADBV to purchase equipment. The members pool their funds to meet the down-payment requirements. The leader is responsible for equipment rental and repair and for loan repayment.
2. Group loans. These differ from the "master borrower" loans in that each member of the group is responsible to the ADBV for a portion of the total loans. For example, 10 fisherman may need two million piasters to modernize a fishing boat. Each would sign a note with the ADBV for 200,000 piasters and the boat would serve as collateral until the entire loan is repaid.

3. Supervised credit. This involves the furnishing of technical and credit assistance to farmers so they can increase production by increasing their technical knowledge. The ADBV is currently supplying this service in several villages where the volume is great enough to justify the full-time assignment of a technician. The shortage of trained personnel is the biggest obstacle to enlarging the program.

4. Loans to cooperatives. In 1970 the three national farm organizations received import loans of 1,831.8 million piasters and 11 small cooperatives received loans totaling 67.0 million piasters. Most of the money went for fertilizer, tractors, and other small farm machinery. The Agricultural Development Bank of Vietnam will continue its program of establishment of new bank branches and expand agricultural credit to benefit farmers and fishermen. The ADBV will carry out the following activities:

    a. Increase credit to support agricultural production.

    b. Guide and assist the development of private credit institutions.

    c. Consolidate the ADBV's structure as well as its personnel. In addition, it will seek to improve the operations of its branches and local offices, and to open new ones.

       Regarding the problem of personnel, the ADBV will increase the members of credit controllers; also, training and counseling activities will be emphasized for its personnel.

    d. Increase the ADBV's working capital. In the first year of the Plan (four year 1972-75 National Economic Development Plan) the bank's capital is expected to increase to 15 billion piasters. Credit will be expanded by raising medium and long-term loans from the present level of 10 percent of the total loans

extended by the Bank. High priority will be given to agricultural development programs. This credit level is expected to increase steadily in the following years.

e. Achieve self-sufficiency in working capital by stepping up services in savings and deposits, and increasing the Bank's reserves once the amount of credit granted has increased sufficiently. At the same time, the ADBV will study and carry out appropriate measures to raise investment stocks in the Bank.

In addition to the above tasks, the Bank will support the establishment of a credit institution which is oriented towards development activities and provide assistance for private credit organizations and particularly expand the Rural Bank System to ensure the establishment of 20 additional Rural Banks each year. The ADBV will coordinate with the Directorate of Farmer's Associations and the Directorate of Cooperatives, in order to guide and assist in the organization of Rural Credit Cooperatives, and conduct a study on the establishment of a Cooperative Bank.

The development of agriculture can be achieved more rapidly, Saigon planners agree, if sufficient credit is made available to commercial farmers, plantation owners, and manufacturers supporting the fields of agriculture, fisheries and forestry. But until recently 90 percent of the ADBV's customers were small farmers borrowing less than 50,000 piasters each. Since so little capital was left over for long-term loans, two new credit systems were established in 1970.

The New Credit Systems

Village Credit Committees

The ADBV has evolved a new plan for reaching villagers and for processing their loan applications as approved by the ADBV's board of directors. Thus, the bank will begin calling on elected village committees for help in processing loan applications.

Although the ADBV maintains a branch or lending representative in each of the provinces, its operations have been hampered by a shortage of field personnel to supervise loans. If the village committee can receive and approve and supervise the smaller loans for ADBV, it will be advantageous in two ways: ADBV will be able to provide credit to more people and the elected village officials will be serving their committees in a meaningful way.

Village credit committees were formed to screen applications for loans under 50,000 piasters and to be responsible for collecting them. To date, 1,094 village committees have been organized and 955 of these now have members who have received credit training from the ADBV. The committees are composed of village officials and respected members of the community. Some 2,100 villages have been certified to participate in this program, which is geared in with the government's Village Self Development (VSD) program. The 1971 program under VSD includes the development of a rural credit program to spur the launching of community income-producing projects. Placing income-producing projects on a loans basis, instead of the grant basis still used for so-called "public use projects," is another step toward the government's goal of self-reliance at the grassroots. To get this phase of the program started, all villages

will be given an initial fund of 400,000 piasters, larger villages getting proportionately more. All of these funds may be used for public use projects, such as the construction of a school. But at the discretion of the village council, up to half of these funds may be utilized in income-producing projects, such as the purchase or construction of a rice mill. Since all such income-producing projects now are to be financed on a loan basis, the projects must be cleared through the village's credit committee.

Rural Banks

The government is encouraging private commercial banks to open rural branches and accept the risks inherent in medium-term, low-interest agricultural loans. In a move expected to help stimulate the private sector to invest more liberally in agriculture, the government has just given the go-ahead signal to a new system of specialized rural banking. The first such rural branch banks opened in two districts of Angiang province. Patterned after the Philippines' rural banks and organized with Filipino assistance, they are privately owned but government-assisted in order to meet the needs of small farmers who could not meet ordinary banking requirements for collateral. Within five years, there will probably be 200 rural banks operating throughout South Vietnam, even in the most remote areas.

Expenses of this far-reaching project are being shared equally by the Vietnamese and U.S. governments. The objectives of the program will be two-fold: 1) to break the moneylenders' hold on the farmer by pulling down the cost of rural credit, and 2) to assure a solid credit supply for development of rural areas. Loans will be made available

to farmers cultivating fewer than 10 hectares (which includes the very great majority), to merchants with capital investments of less than 500,000 piasters, and to operators of agricultural industries capitalized at less than one million piasters. Under the system, a rural bank may be chartered by seven to 15 "legally qualified people" living in a community, thus assuring management and operation by local people who know the abilities of local borrowers.

The rural banking system will fill a long-felt need, since commercial banks in the private sector now devote only about one percent of their loans to agriculture, and the government-sponsored Agricultural Development Bank does not have sufficient funds to meet the swelling demand for farm credit.

Reforming the credit system goes hand in hand with encouraging the growing of high-yield rice varieties, for both are necessary before the average Vietnamese farmer can move from subsistence to commercial farming. Advances made in rice production and financing can be extended to other agrarian fields, such as vegetable production.

CHAPTER IV
RESULTS OF THE LINEAR PROGRAMMING ANALYSIS

The overall objective of this research is to provide guidelines for the optimum allocation of scarce agricultural resources in South Vietnam which will maximize national and/or regional farm income, as well as fulfill national and/or regional requirements for domestic food consumption. A complex linear programming model is utilized to determine not only the optimum allocation of cropland among alternative enterprises, but also such important development factors as capital investment requirements, foreign exchange, commodity exports and imports, food processing capital requirements, and optimum livestock and livestock product combinations.

This research builds upon the pioneering work of Bolton, et al. [10]. A comparison of Bolton's results with an optimum solution representing more recent (1973) prices is provided (Tables 4.1, 4.2, 4.3, 4.4). The effects of variations in capital constraints are described in Tables 4.9 to 4.16. Hypothetically reducing the country's geographical space to the Delta region plus one-half of the Eastern region provides some additional and interesting results (Tables 4.5, 4.6, 4.7, 4.8).

Shadow Prices

Given input quantities and output prices, there is one optimum set of output quantities derived from linear programming. This also shows

that there is one set of input values or shadow prices. The shadow price derived from linear programming is the counterpart of the marginal value product derived from production economics. Free resources do not limit production in the optimum solution. Scarce resources, on the other hand, do limit production. Only resources which are scarce have positive marginal value productivities. The marginal value productivities are of interest since they indicate possible gains in income through acquisition of scarce resources. Free resources have zero value in the production process. Addition or subtraction of one unit of free resources will not affect incomes.

In the 50 percent and 10 percent of capital constraint solutions of the standard model, the shadow prices of capital are 806 and 3,299 thousand piasters, respectively. That is, if one thousand piasters of additional capital were introduced into the solution, income would be increased by 806 and 3,299 thousand piasters, respectively. For the reduced model, shadow prices of capital are 292 and 959 thousand piasters, respectively. That is, if one thousand piasters of additional capital were introduced into the solution, income would be increased by 292 thousand piasters if capital is constrained 50 percent and 959 thousand piasters if capital is constrained 10 percent of standard amount.

Consumer Surplus

Consumer surplus is the difference between the prices consumers are willing to pay and the market price. Consumer surplus can be defined in this study as the difference between total and farm income. It represents the monetary advantage accruing to consumers from lower prices on those commodities with production in excess of domestic

consumption requirements, i.e. consumption expenditures for commodities being exported are reduced by amounts reflecting the difference between their import and export prices [10]. With both the 50 percent and 10 percent of capital constraints in the Standard National Model, consumer surplus is reduced 5 percent because rice, soybean meal, and pork are imported (Table 4.9). In the reduced model, consumer surplus increases 306 percent when compared with the standard model because rice moves into export in large volume (Table 4.5). With both capital constraints in the reduced model, consumer surplus decreases 26 percent because smaller quantities of rice are exported (Table 4.13).

Comparison of Optimum Solution Under 1971 and 1973 Price Levels

Given the high degree of inflation which existed in South Vietnam during the 1971-73 period, it was deemed important to determine whether price level changes had any major effect upon the optimum solutions obtained by Bolton for 1971 data. Tables 4.1, 4.2, 4.3, 4.4 provide a comparison of the linear programming results for 1971 and 1973 data.

In the optimum solution assuming 1973 prices, agricultural income (Table 4.1) increased by 152.7 billion piasters (51 percent) over the solution utilizing 1971 prices. This increase in farm income is due to increased paddy production and increased livestock production. Paddy production increases 73,300 M.T., while pork production increased 12,500 M.T. (4 percent), chicken production 8,300 M.T. (9 percent) and beef production 26,100 M.T. (43 percent).

Cropland

The higher price levels of 1973 did not materially affect the optimum solutions regarding cropland combinations. Generally speaking, there were slight shifts among different rice varieties in the Delta and Eastern regions. For the national model (Table 4.1), the percentage of total rice land of the total crop area was unchanged. But total rice land increased 44,700 hectares and total cropland increased approximately 44,500 hectares. The high yielding variety (HYV) rice area increased 42,000 hectares (3 percent), and the floating rice area increased 181,900 hectares (27.7 percent), whereas non-floating rice decreased 179,100 hectares (-9 percent). No significant displacement of rice with the other crops occurred.

On the regional basis (Table 4.1), cropland and production changes associated with 1973 prices occurred primarily in the Delta region. In the Delta region the non-floating rice area decreased 184,300 hectares (-14 percent), HYV rice area increased 36,200 hectares (4 percent), and floating rice increased 181,900 hectares (28 percent). Bananas cropland increased 2,400 hectares (92 percent), while the other crops hectarages remained unchanged. The rice area occupies 92 percent of the total land in the Delta region. Sorghum and coconut are other important crops.

In the Eastern region, the optimum rice area increased slightly or 5,200 hectares (2 percent); the HYV rice area accounted for all of the increase in rice hectarage. Bananas decreased 2,500 hectares (-41 percent). The other crop hectarages remained unchanged. Cropland devoted to rice occupied 72 percent of the Eastern region; rubber is the second most important crop in this region.

The inflation in prices between 1971 and 1973 did not have any significant effect upon the optimum solutions for the Lower Coastal, Central Coast, North Coastal, and Highland regions.

Production

National crop production of the optimum solution under 1973 prices remained unchanged compared with 1971 price levels, except rice and banana production changed slightly. Rice production (Table 4.2) increased 73,200 M.T. (1 percent) for paddy fed because of the increased 44,700 hectares of the rice crop, while banana production decreased 6,400 M.T. (-3 percent). Livestock production (Table 4.4) increased. Pork production increased 12,500 M.T. (4 percent), chicken production increased 8,300 M.T. (9 percent) and beef production increased 26,100 M.T. (43 percent). Future commercial broilers enter the optimum solution under 1973 price level in the Central, North and Highland regions.

Capital, Facilities, and Foreign Trade

Total new capital requirements (Table 4.1) amounted to 67.2 billion piasters with 1973 price levels. This is 19.9 billion piasters or 43 percent above new capital requirements for 1971 prices. This increased amount is due to increased production facilities and because of the increased inflation rate. Three-fifths of this amount represents requirements for production facilities and two-fifths for distribution facilities. About 68 percent of new capital requirements involves the expenditure of foreign exchange. Importation of additional work stock and new tools accounts for a major share of the production capital requirements. Since the rice area increased 44,700 hectares in the Delta

and Eastern regions, expenditures for sprayers increased 25 percent and pumps increased 7 percent. Cattle and buffalo increased in every region, except in the Central Coastal region. Imported cattle and buffalo increased 308 percent for South Vietnam. Increased workstock numbers provide increased beef production, and lead to zero imports of beef products. Cattle imported for this purpose represent a one time investment and foreign exchange requirement. Additional livestock numbers supply beef as well as power. Crop power requirements increased generally, except in the Central Coastal region.

New facility requirements (Table 4.3) are very slightly changed with changes in price levels between 1971 and 1973. Grain storage and rubber processing are the major items requiring capital for new distribution facilities. The annual trade deficit (Table 4.1) declined 7.2 billion piasters (-14 percent). The improvement in the trade balance resulted entirely from a reduction of commodity imports. Imports decreased 7.1 billion piasters (-8 percent) and exports increased .1 billion piasters. Rubber and bananas are the most significant export items under both 1971 and 1973 prices. Domestic coconut meal and copra are available for export. The value of commodity exports is 39.4 billion piasters while the value of imports included in this analysis is 83.3 billion piasters. Therefore, the annual commodity trade deficit is -43.9 billion piasters with 1973 prices.

Raw sugar, wheat, flour, refined sugar and soybean meal are the most important items imported in the optimum solution. No rice is imported. Corn enters into the import solution up to 16,400 M.T. to feed livestock because corn and sorghum production do not increase while livestock production increases. Imported soybean meal is increased

Table 4.1 General Results. Comparison of Optimum Solution Under 1971 and 1973 Price Levels

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	--------Billion Piasters--------		
Farm Income	302.1	454.8	51
Consumer's Surplus	7.8	7.8	
Total	309.9	462.6	49
Annual Foreign Exchange			
Commodity Export	39.3	39.4	a
Commodity Import	54.7	46.0	-16
Annual Inputs	35.7	37.3	4
Imports	90.4	83.3	-8
Annual Balance	-51.1	-43.9	-14
Capital Investment (One-Time Requirement)			
Production	21.7	41.4	91
Distribution	25.6	25.8	a
Total	47.3	67.2	43
Foreign Exchange	29.2	45.6	56
	------Thousand Metric Tons------		
Exports			
Rice	0	0	
Corn	0	0	
Sorghum	0	0	
Soybeans	0	0	
Peanuts	0	0	
Peanut Oil	0	0	
Rubber	167.9	167.9	
Tea	.5	.7	a
Coffee	2.7	2.7	
Coconut Meal	8.6	8.6	
Copra	28.9	28.9	
Pineapple	0	0	
Bananas	200.0	200.0	
Wheat Bran	0	0	

Table 4.1 - continued

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	------Thousand Metric Tons------		
Exports (cont.)			
Duck Feathers	.9	.9	
Pork	0	0	
Chicken	0	0	
Duck	2.0	2.0	
Chicken Eggs	1.1	1.1	
Imports			
Rice		16.4	
Corn	0	0	
Soybean Meal	39.5	45.2	14
Soybean Oil	0	0	
Raw Sugar	286.6	290.0	1
Sugar	99.2	96.0	-3
Jute	0	0	
Flour	107.1	107.1	
Wheat	185.9	185.9	
Cotton	39.4	39.4	
Pork	17.8	10.0	-44
Chicken	5.8		
Beef	14.4		
	--------Thousand Hectares-------		
Crops			
Rice, Non-Floating	1983.9	1804.8	-9
Rice, HYV	1357.5	1399.5	3
Rice, Floating	656.3	838.2	28
Corn	88.0	87.6	a
Sorghum	349.8	349.8	
Soybeans	0	0	
Peanuts	67.3	67.3	
Sugarcane	4.4	4.4	
Tobacco	20.2	20.2	
Rubber	140.0	140.0	
Tea	7.2	7.5	a
Coffee	7.0	7.0	
Coconut	40.0	40.0	

Table 4.1 - continued

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	--------Thousand Hectares-------		
Crops (cont.)			
Pineapple	0	0	
Bananas	8.6	8.4	-2
Jute	11.1	11.1	
Kenaf	0	0	
Delta Crops			
Rice, Non-Floating	1346.0	1161.7	-14
Rice, HYV	869.3	905.5	4
Rice, Floating	656.3	838.2	28
Sorghum	178.0	178.0	
Peanuts	7.0	7.0	
Tobacco	10.0	10.0	
Coconut	40.0	40.0	
Pineapple	0	0	
Bananas	2.5	4.8	92
Jute	0	0	
Kenaf	0	0	
Eastern Crops			
Rice	218.1	223.3	2
Rice, HYV	194.7	199.9	3
Corn	16.0	16.0	
Sorghum	0	0	
Soybeans	0	0	
Peanuts	10.7	10.7	
Sugarcane	0	0	
Tobacco	10.3	10.3	
Rubber	120.0	120.0	
Coffee	0	0	
Pineapple	0	0	
Bananas	6.1	3.6	-41
Jute	0	0	
Lower Coastal Crops			
Rice	104.5	104.5	
Rice, HYV	91.8	91.8	
Corn	2.4	2.4	

Table 4.1 - continued

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	--------Thousand Hectares-------		
Lower Coastal Crops (cont.)			
Sorghum	17.7	17.7	
Soybeans	0	0	
Peanuts	4.8	4.8	
Jute	.7	.7	
Central Coastal Crops			
Rice	146.3	146.3	
Rice, HYV	101.9	101.9	
Corn	2.3	2.3	
Sorghum	61.7	61.7	
Peanuts	10.8	10.8	
Sugarcane	4.4	4.4	
Jute	5.1	5.1	
North Coastal Crops			
Rice	134.2	134.2	
Rice, HYV	65.1	65.7	1
Corn	21.1	21.1	
Sorghum	86.6	86.6	
Peanuts	7.9	7.9	
Jute	5.3	5.3	
Highland Crops			
Rice	34.7	34.7	
Rice, HYV	34.7	34.7	
Corn	46.2	45.8	-1
Sorghum	5.8	5.8	
Soybeans	0	0	
Peanuts	26.1	26.1	
Rubber	20.0	20.0	
Tea	7.2	7.5	4
Coffee	7.0	7.0	

[a]Less than one percent.

Table 4.2 National Crop Production. Comparison of Optimum Solution under 1971 and 1973 Price Levels

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	------Thousand Metric Tons------		
Paddy Marketed	3419.9	3419.6	a
Paddy Home Use	3328.5	3328.8	a
Paddy Fed	295.9	569.1	15
Total Paddy	7244.3	7317.5	1
Rice Fed	0	0	
Corn Marketed	86.6	86.3	a
Corn Home Fed	100.9	100.7	a
Total Corn	187.5	187.0	a
Sorghum Marketed	150.6	150.6	
Sorghum Home Fed	351.4	351.4	
Total Sorghum	502.0	502.0	
Soybeans	119.0	119.0	
Peanuts	220.0	220.0	
Sugarcane	25.9	25.9	
Tobacco	176.0	176.0	
Rubber	6.4	6.6	0
Tea	8.4	8.4	
Coffee	480.0	480.0	
Coconut	0	0	
Pineapple	0	0	
Bananas	215.3	208.9	-3
Jute	11.1	11.1	
Kenaf	0	0	

[a]Less than one percent.

Table 4.3 New Facility Requirements. Comparison of Optimum Solution under 1971 and 1973 Price Levels

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	----------Units----------		
Tobacco Processing			
East	.5	.5	
Banana Marketing			
Delta	1.0	2.0	
East	2.3	1.3	-44
Fiber Processing			
East	2.6	2.6	
Rubber Processing			
East	106.0	106.0	
Highland	20.0	20.0	
Tea Processing			
Highland	3.5	4.3	23
Rice Mill			
East			
Lower Coast	7.2	7.2	
Highland	3.0	3.0	
Rice Drying			
Delta	52.1	52.1	
East	12.1	12.1	
Grain Storage			
Delta	280.5	280.4	a
East	0	0	
Lower Coast	0	0	
Highland	26.6	26.5	

Table 4.3 - continued

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	----------Units----------		
Threshing-Shelling			
Delta	194.2	194.2	
East	17.4	17.4	
Lower Coast	27.9	27.9	
Central Coast	94.0	94.0	
North Coast	136.8	136.8	
Highland	64.7	64.4	a
Feed Mill			
Delta	2.8	2.8	
Lower Coast	.7	1.0	43
Central Coast	1.5	1.4	a
North Coast	1.3	2.9	123
Highland	5.8	5.9	a
Oil Mill			
Delta	.7	.7	
East	.3	.3	
Lower Coast	.1	.1	
Central Coast	.3	.3	
North Coast	.2	.2	
Highland	.8	.8	
Sugar Mill			
East	0	0	
Sugar Refinery			
East	0	0	
Central Coast	.2	.2	

[a]Less than one percent.

Table 4.4 Livestock and Livestock Products. Comparison of Optimum Solutions under Alternative Price Situations, South Vietnam

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	-------Thousand Metric Tons--------		
Pork[a]			
Delta	166.1	178.1	7
Eastern	60.2	60.2	
Lower	17.0	17.5	b
Central	32.2	31.5	-2
North	39.0	39.5	1
Highland	26.7	27.0	4
Vietnam	341.2	353.7	4
Chicken[a]			
Delta	52.4	52.4	
Eastern	19.3	19.3	
Lower	3.8	3.8	
Central	5.9	7.1	20
North	6.3	13.3	111
Highland	2.5	2.7	8
Vietnam	90.2	98.5	9
Duck[a]			
Delta	44.3	44.3	
Eastern	6.7	6.7	
Lower	1.9	1.9	
Central	2.1	2.1	
North	1.9	1.9	
Highland	.1	.1	
Vietnam	57.0	57.0	
Chicken Egg			
Delta	20.8	20.8	
Eastern	10.4	10.4	
Lower	1.9	1.9	
Central	2.9	2.9	
North	3.1	3.1	
Highland	1.5	1.5	
Vietnam	40.6	40.6	

Table 4.4 - continued

Item	Optimum Solution of Bolton (1971 Prices)	Optimum Solution of Standard National Model (1973 Prices)	Percent Change
	-------Thousand Metric Tons--------		
Duck Egg			
Delta	9.6	9.6	
Eastern	.2	.2	
Lower	.7	.7	
Central	.9	.9	
North	.8	.8	
Highland	.1	.1	
Vietnam	12.3	12.3	
Beef[a]			
Delta	27.6	32.1	16
Eastern	8.1	23.9	195
Lower	6.2	6.4	3.2
Central	9.3	9.3	
North	5.8	10.0	72
Highland	3.1	4.4	42
Vietnam	60.1	86.2	43

[a]Live weight.

[b]Less than one percent.

(14 percent). Imported pork is reduced about 7,800 (-44 percent). Chicken and beef go out of import solution due to increased domestic beef and chicken production.

Comparison of the Reduced Model Results with the Standard Model

This section provides a comparison of the standard model which utilizes 1973 prices with a geographically reduced model comprising the Delta region plus one half of the Eastern region. Saigon is located within the reduced region.

In the optimum solution of the reduced model, farm income is decreased to 195.4 billion piasters or 57 percent of the standard national model. Consumer surplus increases to 31.7 billion piasters or an increase of 306.4 percent compared with the standard optimum model, primarily because of the shift in rice prices from import to export levels. Combining farm incomes and consumers' surplus provides a measure of total income which is reduced to 235.5 billion piasters or -51 percent (Table 4.5).

Cropland

Comparing the optimum results of the standard and reduced models, total cropland (Table 4.5) decreased 1,226,100 hectares or 26 percent. Total rice land decreased 822,500 hectares or -20 percent. The non-floating rice area reduced slightly or 258,800 hectares (-14 percent), the HYV rice area reduced 381,900 hectares (-27 percent), and the floating rice area reduced 181,900 hectares (-22 percent). Other crop areas are reduced sharply. For example, the corn area reduced

drastically (-95 percent). Sorghum cropland is nearly reduced in half. The peanut area is also reduced greatly or -77 percent. The sugarcane area is reduced more than one half (-59 percent). Tobacco hectarage is reduced -38 percent. Rubber is reduced in area to more than one half. The jute area is reduced nearly in half.

Soybeans and pineapple enter the optimum solution with 1,100 and 10,000 hectares, respectively, for the reduced model. The coconut area remains unchanged, whereas the banana area increased slightly (2 percent). Rice, sorghum, rubber, coconut, and peanuts are important crops in the reduced model (Table 4.5).

On a regional basis (Table 4.5), there were some changes in the Delta region, i.e., the non-floating rice area increased 16 percent, the floating rice area decreased -22 percent and the HYV rice area decreased -4 percent. Tobacco decreased in area -21 percent and banana hectarage was reduced -48 percent compared with the standard optimum solution. Sorghum maintained the same cropland level. In the Eastern region the non-floating rice area decreased -11 percent and the HYV rice area was reduced -27 percent. The corn area decreased drastically (-74 percent), while peanuts (-18 percent), tobacco (-54 percent), and rubber (-48 percent) decreased. Banana cropland increased (69 percent). No sorghum is produced in this region. Soybeans entered the reduced model solution for the first time.

Because of the comparative advantage of rice in the Delta and Eastern region, it is the dominant enterprise in the reduced model. In the Delta region rice cropland occupies 92 percent of the total, leaving only 8 percent of the cropland for the other crops. Sorghum is the second most important crop. In the Eastern region the rice area

occupies 78 percent of the cropland, permitting 22 percent of the total crop area for the other crops. Rubber is a second important crop in this region.

Production

In terms of livestock production the reduced model provides a reduction for all items when compared with the standard model which utilizes 1973 prices (Table 4.8). Beef production is reduced -59 percent. In the reduced model poultry (chicken and duck) and pork production satisfy domestic consumption requirements and give a small amount for export. No small commercial poultry enterprises are included as alternative enterprise possibilities. Poultry production (chicken, broilers, layers) of the Delta region and one half of the Eastern region remains at the same level, except Eastern farm type enterprises decreased 32 percent.

Capital, Facilities and Foreign Trade

In the reduced model total capital investment (Table 4.5) is 29.0 billion piasters. This is a reduction of 38.2 billion piasters or -57 percent from the standard national model. Production capital is reduced -29.5 billion piasters (-71 percent) and distribution capital is decreased 8.7 billion piasters (-34 percent). In this solution, capital investment for production facilities is 41 percent, with 59 percent for distribution facilities. About 67 percent of total new capital requirements would involve the expenditure of foreign exchange. In the reduced model, sprayers and pumps required in the Lower, Central, and North Coastal regions go out of the optimum solutions. Sprayers

and pumps required in the Delta, Eastern, and Highland regions are reduced 2544 (-38 percent) and 726 (-19 percent), respectively. The number of cattle and buffalo are reduced 64,921 or -8 percent and 225,082 or -49 percent for the Delta and Eastern regions, respectively. Imported cattle and buffalo are reduced 74,803 or -75 percent. Decreased numbers of workstock reduce beef production in the reduced model.

In general only facilities related to rice exist in the reduced model (Table 4.7). Eastern fiber processing, Eastern rubber processing, Eastern threshing-shelling and Delta feed milling are reduced drastically. However, oil mills increase their activity slightly. Tobacco, tea, and sugarcane processing are eliminated from the reduced model solution. Rice drying and grain storage are changed slightly. In order of priority, grain storage, rubber processing, and oil milling are important facilities requiring capital.

The trade deficit (Table 4.5) is reduced to -1.2 billion piasters or 97 percent because commodity exports increase to 54.4 billion piasters or 38 percent and imports are reduced to 55.6 billion piasters or 33 percent. Most improvement in the trade balance deficit is from a reduction of imports and an increase of exports, particularly rice.

Rice and pineapples enter into the export solution. A larger amount of paddy is fed to livestock and a substantial quantity of rice is exported. Rice, bananas, pineapple, and rubber are the most significant export items. Export rubber decreases more than one half and export copra is reduced about a half, whereas exports of coconut meal increase 60 percent.

Feed grains are not imported in the reduced model. Production of feed grains is adequate to feed livestock and livestock is exported,

Table 4.5 General Results. Comparison of Optimum Solutions of the Reduced Model with the Standard National Model

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	--------Billion Piasters---------		
Farm Income	454.8	195.4	-57
Consumers' Surplus	7.8	31.7	306
Total	462.6	227.1	-51
Annual Foreign Exchange			
Commodity Export	39.4	54.4	38
Commodity Import	46.0	31.1	-32
Annual Inputs	37.3	24.5	-34
Imports	83.3	55.6	-33
Annual Balance	-43.9	-1.2	-97
Capital Investment (One-Time Requirement)			
Production	41.4	11.9	-71
Distribution	25.8	17.1	-34
Total	67.2	29.0	-57
Foreign Exchange	45.6	19.1	-58
	------Thousand Metric Tons-------		
Exports			
Rice		537.2	
Corn	0	0	
Sorghum	0	0	
Soybeans	0	0	
Peanuts	0	0	
Peanut Oil	0	0	
Rubber	167.9	75.3	-55
Tea	.7		
Coffee	2.7		
Coconut Meal	8.6	13.9	62
Copra	28.9	13.7	-53
Pineapple		80.0	
Bananas	200.0	200.0	
Wheat Bran	0	0	
Duck Feathers	.9	.9	

Table 4.5 - continued

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	------Thousand Metric Tons-------		
Exports (cont.)			
Pork		5.0	
Chicken		1.3	
Duck	2.0	5.0	150
Chicken Eggs	1.1	1.1	
Imports			
Rice	0	0	
Corn	16.4		
Soybean Meal	45.2	34.2	-24
Soybean Oil	0	0	
Raw Sugar	290.0	252.4	-13
Sugar	96.0		
Jute	0	1.2	
Flour	107.1	20.8	-81
Wheat	185.9	185.9	
Cotton	39.4	25.6	-35
Pork	10.0		
Chicken	0	0	
Beef		11.2	
	--------Thousand Hectares--------		
Crops			
Rice, Non-Floating	1804.8	1546.0	-14
Rice, HYV	1399.5	1017.6	-27
Rice, Floating	838.2	656.3	-22
Corn	87.6	4.2	-95
Sorghum	349.8	178.0	-49
Soybeans		1.1	
Peanuts	67.3	15.8	-77
Sugarcane	4.4	1.8	-59
Tobacco	20.2	12.6	-38
Rubber	140.0	62.0	-56
Tea	7.5		
Coffee	7.0		
Coconut	40.0	40.0	
Pineapple		10.0	
Bananas	8.4	8.6	2
Jute	11.1	5.7	-49
Kenaf		.4	

Table 4.5 - continued

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	--------Thousand Hectares--------		
Delta Crops			
Rice, Non-Floating	1161.7	1346.3	16
Rice, HYV	905.5	870.7	-4
Rice, Floating	838.2	656.3	-22
Sorghum	178.0	178.0	
Peanuts	7.0	7.0	
Tobacco	10.0	7.9	-21
Coconut	40.0	40.0	
Pineapple	0	0	
Bananas	4.8	2.5	-48
Jute		1.5	
Kenaf		.3	
Eastern Crops			
Rice	223.3	199.7	-11
Rice, HYV	199.9	146.9	-27
Corn	16.0	4.2	-74
Sorghum	0	0	
Soybeans		1.1	
Peanuts	10.7	8.8	-18
Sugarcane		1.8	
Tobacco	10.3	4.7	-54
Rubber	120.0	62.0	-48
Coffee	0	0	
Pineapple		10.0	
Bananas	3.6	6.1	69
Jute		4.2	

Table 4.6 National Crop Production. Comparison of Optimum Solutions of the Reduced Model with the Standard National Model

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	-------Thousand Metric Tons-------		
Paddy Marketed	3419.6	3048.9	-11
Paddy Home Use	3328.8	2330.7	-30
Paddy Fed	569.1	618.2	9
Total Paddy	7317.5	5997.8	-18
Rice Fed	0	0	
Corn Marketed	86.3	4.3	-95
Corn Home Fed	100.7	3.9	-96
Total Corn	187.7	8.2	-96
Sorghum Marketed	150.6	116.5	-23
Sorghum Home Fed	351.4	97.1	-72
Total Sorghum	502.0	213.6	-58
Soybeans		1.4	
Peanuts	119.0	27.7	-77
Sugarcane	220.0	146.0	-34
Tobacco	25.9	16.8	-35
Rubber	176.0	80.5	-54
Tea	6.6		
Coffee	8.4		
Coconut	480.0	480.0	
Pineapple		80.0	
Bananas	208.9	215.3	3
Jute	11.1	5.7	-49
Kenaf		.4	

Table 4.7 New Facility Requirement. Comparison of Optimum Solutions of the Reduced Model with the Standard National Model

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	----------Units----------		
Tobacco Processing			
East	.5		
Banana Marketing			
Delta	2.0	1.0	-50
East	1.3	2.3	77
Fiber Processing			
East	2.6	.6	-77
Rubber Processing			
East	106.0	30.5	-71
Highland	20.0		
Tea Processing			
Highland	4.3		
Rice Mill			
East	0	0	
Lower Coast	7.2		
Highland	3.0		
Rice Drying			
Delta	52.1	52.6	1
East	12.1	12.1	
Grain Storage			
Delta	280.4	232.0	-17
East	0	0	
Lower Coast	0	0	
Highland	26.5		

Table 4.7 - continued

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	----------Units----------		
Threshing-Shelling			
Delta	194.2	194.2	
East	17.4	3.9	-78
Lower Coast	27.9		
Central Coast	94.0		
North Coast	136.8		
Highland	64.4		
Feed Mill			
Delta	2.8	1.4	-50
Lower Coast	1.0		
Central Coast	1.4		
North Coast	2.9		
Highland	5.9		
Oil Mill			
Delta	.7	1.1	57
East	.3	.3	
Lower Coast	.1		
Central Coast	.3		
North Coast	.2		
Highland	.8		
Sugar Mill			
East	0	0	
Sugar Refinery			
East	0	0	
Central Coast	.2		

Table 4.8 Livestock and Livestock Products. Comparison of Optimum Solutions of the Reduced Model with the Standard National Model

Item	Optimum Solution of the Standard National Model	Optimum Solution of the Reduced Model	Percent Change
	--------Thousand Metric Tons--------		
Pork[a]			
Delta	178.1	188.2	6.7
Eastern	60.2	59.8	-1
Lower	17.5		
Central	31.5		
North	39.5		
Highland	27.0		
Vietnam	353.7	248.0	-30
Chicken[a]			
Delta	52.4	52.4	
Eastern	19.3	13.5	-30
Lower	3.8		
Central	7.1		
North	13.3		
Highland	2.7		
Vietnam	98.5	65.9	-33
Duck[a]			
Delta	44.3	35.7	-19
Eastern	6.7	6.7	
Lower	1.9		
Central	2.1		
North	1.9		
Highland	.1		
Vietnam	57.0	42.4	-26
Chicken Egg			
Delta	20.8	18.5	-11
Eastern	10.4	8.1	-22
Lower	1.9		
Central	2.9		
North	3.1		
Highland	1.5		
Vietnam	40.6	26.7	-34

Table 4.8 - continued

Item	Optimum Solution of the Standard National Model	Optimum Standard of the Reduced Model	Percent Change
	--------Thousand Metric Tons--------		
Duck Egg			
Delta	9.6	7.8	-19
Eastern	.2	.2	
Lower	.7		
Central	.9		
North	.8		
Highland	.1		
Vietnam	12.3	8.0	-35
Beef[a]			
Delta	32.1	27.6	-14
Eastern	23.9	8.1	-66
Lower	6.4		
Central	9.3		
North	10.0		
Highland	4.4		
Vietnam	86.2	35.7	-59

[a]Live Weight.

except beef. However, pork, chicken and duck export quantities are quite small.

Imported pork and sugar are eliminated in the reduced model. Because of reduced domestic consumption requirements, imports of soybean meal, raw sugar, flour, and cotton are reduced.

Comparison of the Results of the Standard Model with Models Which Constrain Capital

Because of the importance of capital and credit for agricultural development in South Vietnam, the standard optimum solution was compared with optimum solutions which reduced the capital constraint to 50 percent and 10 percent of the amount available in the standard solution. Testing the sensitivity of the standard optimum solution for varying capital supply constraints will provide an analysis of the types of adjustment expected.

The limitations of capital to 50 percent and 10 percent reduce total income 9 billion piasters (-2 percent) and 65.8 billion piasters (-14 percent), respectively, when compared with the standard optimum solutions.

Cropland

Reduction in the available capital supply has the general effect of reducing the amount of land resources utilized for agriculture. On a national basis (Table 4.9) total cropland is reduced 144,600 hectares (-3 percent) and 309,800 hectates (-6 percent) for 50 percent and 10 percent capital constraints, respectively. Practically all of the decrease in cropland in the 50 percent reduction was accounted for by

the 142,000 (4 percent) hectares drop in total rice land. Rice land decreased merely 38,000 hectares or 1 percent for the 10 percent capital constraint. Percentage of total rice land of the total crop area for the 50 percent capital constraint remained similar to the standard model (84 percent compared with 84.5 percent). However, rice accounted for 89 percent of the cropland under the 10 percent capital constraint.

With both capital constraints, the non-floating rice areas are increased slightly, while HYV and Delta floating rice areas are decreased totally for the whole nation. Optimum rice, corn, sorghum, rubber, tea, banana, and jute hectarages are decreased, whereas peanut, tobacco, and coffee hectarages are increased slightly. The coconut hectarage remains unchanged. Pineapples come into the optimum solution for the 10 percent capital constraint. Soybeans do not enter into the standard and capital constraint solutions. Sugarcane is eliminated with the capital constraints.

Fifty percent of capital constraint

On a regional basis (Table 4.9) and assuming 50 percent of optimum capital, the proportion of Delta rice land to Delta total crop land remains the same (92 percent). However, Delta rice land is reduced about 104,200 hectares (-4 percent) and Delta total crop land is reduced 96,900 hectares (-3 percent). The other crop areas remain the same, except that the tobacco and banana areas are increased. Thus, there is some shift in rice land to tobacco and banana crops within the region.

In the Eastern region the proportion of rice land to the total crop land remains unchanged at 72 percent compared with the standard

model results. However, rice land is reduced 32,900 hectares (-8 percent) and total cropland is reduced 38,300 hectares (-7 percent). The rice, corn, banana and tobacco hectarages are reduced; the peanut area is increased, while rubber hectarage remains unchanged.

In the Lower Coastal region the proportion of rice land to total crop land (88 percent) remained unchanged. Rice hectarage also remained unchanged. The sorghum area decreased, while the peanut area increased. The displacement of sorghum with peanuts occurred because peanuts are more labor intensive and labor replaces capital when capital is reduced.

In the Central Coastal region, the proportion of rice land to total crop land remains nearly unchanged (76 percent with 50 percent capital constraint compared with 75 percent for the standard model). In terms of actual land area, however, rice land is increased about 15,100 hectares (6 percent) and total crop land is increased about 12,000 hectares (4 percent). Rice, corn, sorghum hectarages increased, whereas the peanut area decreased.

In the North Coastal region total crop land is unchanged and rice land is increased about 1,300 hectares. Rice and peanuts increased in optimum land area, while sorghum and jute hectarages decreased.

In the Highland region the proportion of rice land to total crop land decreased to 30 percent (compared with 38 percent in the standard model). Total crop land in the Highland region decreased 21,300 hectares (-12 percent). All of this decrease was accounted for by rice land, which decreased 31 percent. The non-floating rice area remained unchanged, and only the HYV rice area was reduced. The rice, corn, and tea areas are reduced, whereas optimum peanut hectarage increased.

Ten percent of capital constraint

On a regional basis (Table 4.9) and assuming a 10 percent of capital constraint the proportion of Delta rice land to total crop land is increased slightly (96 percent compared with 92 percent of the standard model). However, Delta rice land is reduced 91,800 hectares (-3 percent) and Delta total crop land is reduced 229,100 hectares (-7 percent). The rice, sorghum, and tobacco areas decreased, while the banana area increased.

In the Eastern region the proportion of rice land to total crop land decreased slightly (71 percent compared with 72 percent of the standard model. Optimum rice land is reduced 36,100 hectares (-9 percent), while total crop land is reduced 41,800 hectares (-7 percent). Rice, rubber, and banana hectarages are decreased, whereas corn, peanut and tobacco areas are increased. Coffee and pineapple come into this solution.

In the Lower Coastal region the proportion of rice land to total cropland is unchanged (88 percent). However, optimum rice land is reduced 23,900 hectares (-12 percent) and total cropland is reduced 25,500 hectares (-11 percent). Rice and sorghum areas decreased whereas corn and peanut areas increased.

In the Central Coastal region the proportion of rice land to total cropland increased (87 percent compared with 75 percent of the standard model). Rice land increased 49,200 hectares (20 percent). Both non-floating and HYV rice areas increased. Therefore, total cropland increased 9,600 hectares (3 percent). Rice and corn areas increased, whereas sorghum, peanut, and jute areas decreased.

In the North Coastal region, the proportion of rice land to total crop land increased (71 percent compared with 62 percent of the standard model). Rice land increased about 20,700 hectares (10 percent). The HYV rice area remained unchanged, while the non-floating rice area increased. Total crop land is decreased 11,600 hectares (-4 percent). Rice and peanut areas increased, whereas the sorghum area decreased.

In the Highland region, the proportion of rice land to total crop land increased 30 percent (68 percent under a 10 percent capital constraint compared with 38 percent of the standard model). Rice land increased 43,600 hectares (63 percent). The HYV rice area decreased, whereas the non-floating rice area increased. Total crop land decreased 15,500 hectares (-9 percent). Rice and peanut areas increased, whereas corn and tea areas decreased.

Production

The general effect of constrained capital (50 percent and 10 percent) is decreased agricultural output derived primarily from decreased rice production. As rice production decreased, there were some shifts away from rice production on low-yield varieties (floating rice) and high yield varieties (HYV) in some regions to average-yield varieties (non-floating rice). Basically, however, agriculture in South Vietnam would continue to centre around rice production under constrained capital situations. Rubber is another important crop in the Eastern and Highland regions. Corn appears in all regions of the country, except the Delta region. Sorghum is an important feed grain crop in the Delta and Coastal regions. Sugarcane, which enters the standard optimum solution in the Central Coastal region, is absent from the 50 percent and

10 percent of capital constraint solutions because sugarcane crops require considerable amounts of capital investment. With the 50 percent and 10 percent of capital constraint solutions, there are relative shifts from rice, sorghum, and the other crops to peanuts. Optimum peanuts crop areas are reduced in the Delta and Central Coastal regions, but are increased in the Eastern, Lower Coastal, North Coastal and Highland regions. Peanuts are a crop for which labor substitutes quite readily for capital (Table 4.9).

In both the 50 percent and 10 percent of capital constraint optimum solutions, paddy production (Table 4.10) decreases slightly and the amount of paddy fed to livestock is increased. Except in the case of hogs and beef, there is little change in the distribution of production among regions. With both 50 percent and 10 percent of capital constraints, livestock (hog, chicken and duck) production tends to follow the location of feed supply. The Delta and Eastern regions are the most important regions for feed supplies.

Chicken production (Table 4.12) changed slightly (-9 percent) in the 50 percent and 10 percent of capital constraint solutions, compared with the standard model results. No small-scale (farm) commercial poultry (chicken, broiler and layer) enterprises are included as alternative enterprise possibilities in the three solutions (standard model and the two capital constraints). Chicken would be imported into the Coastal and Highland regions under the 50 percent and 10 percent of capital constraints because of a reduction in chicken production in these regions. Existing large-scale commercial swine and poultry enterprises are fixed in the various regions in these three solutions. Total local and small commercial hog production is reduced about 4899 (-6 percent)

and 23,388 (-29 percent), respectively for the 50 percent and 10 percent of capital constraints. Beef production decreased in all regions, except the Central Coastal region, because the number of workstock and imported workstock decreased. Imported cattle and buffalo decreased 75,054 (-76 percent) for the 50 percent capital constraint. There was no imported workstock in the 10 percent of capital constraint solution.

Capital, Facilities, and Foreign Trade

With the 50 percent of capital constraint the capital requirement decreased 33.6 billion piasters. Thirty-five percent of the capital requirements is for production facilities, while 65 percent is for distribution facilities. Fifty-seven percent of the new capital requirement involves the expenditure of foreign exchange (Table 4.9).

With the 10 percent of capital constraint, the capital requirement decreased about 60.5 billion piasters (-90 percent). Thirty-six percent of the capital requirement is for production facilities, while 64 percent is for distribution facilities. About 63 percent of the new capital requirements involves the expenditure of foreign exchange (Table 4.9).

With the 50 percent of capital constraint sprayers and pumps required in the Lower, Central, and North Coastal regions remained nearly unchanged, whereas sprayers and pumps required in the Delta, Eastern, and Highland regions are reduced -30 percent and -27 percent, respectively. With the 10 percent of capital constraint, sprayers and pumps required in the Lower, Central, and North Coastal regions are reduced -26 percent and 11 percent, respectively. Sprayers and pumps required in the Delta, Eastern, and Highland regions are reduced -36 percent and -27 percent. With 50 percent and 10 percent of capital constraints,

additional workstock is imported only into the Delta region for the 50 percent of capital constraint.

With the 50 percent of capital constraint, rubber processing and grain storage are the most important new facility requirements. Oil milling and threshing-shelling come into the solution with second priority. With the 10 percent of capital constraint, grain storage and threshing-shelling provide the most capital requirement for new facilities (Table 4.11).

With the 50 percent and 10 percent of capital constraints, annual trade deficits (Table 4.9) increased about 13.9 billion piasters (32 percent) and 45.2 billion piasters (103 percent), respectively. Imports increased about 14.8 billion piasters (18 percent) and 36.7 billion piasters (44 percent), respectively. Commodity exports increased slightly or .8 billion piasters (2 percent) under the 50 percent capital constraint, but decreased 8.4 billion piasters (-21 percent) for the 10 percent of capital constraint. Thus, with 50 percent of optimum capital commodity exports are not affected materially. There are some changes in coconut meal and copra exports, however. Exported tea goes out of the solution. Rubber and bananas are the most important export items. With the 10 percent of optimum capital solutions, commodity exports are affected in the following manner: rubber exports are drastically reduced (-75 percent) compared with standard model results; tea and coconut meal go out the solution; coffee and copra exports increase. Peanut exports come into the solution of the 10 percent of capital constraint. Bananas and peanuts are the most important export items.

With both the 50 percent and 10 percent of capital constraint solutions, most of the trade balance changes result from increased imports of rice and sugar. Rice is imported because of the decrease in high-yield variety rice hectarage. There are reductions in national corp production, except for increased peanut production, because labor substitutes for capital. Corn production decreased -20 percent and -46 percent, respectively for the 50 percent and 10 percent of capital constraints. Corn is not imported in these two solutions. Paddy replaces corn to feed livestock. The sugarcane crop goes out of the 50 percent and 10 percent of capital constraint solutions. Thus, no sugar mill and sugar refinery exist in these two solutions. The quantity of imported sugar obviously increases. The soybean crop does not come into any standard model solution and the two capital constraint solutions. Soybean meal is imported in both the 50 percent and 10 percent of capital constraints and soybean oil is imported in the 10 percent of capital constraint solution. Imported jute comes into these two solutions with small quantities. In the 50 percent and 10 percent of capital constraint solutions, rice, raw sugar, sugar, flour and wheat are the most important imported items. More paddy is used for livestock feed in both solutions. Total production of paddy is very slightly decreased. Relieved pressure for feed grains causes some shifts of land to peanuts. Therefore, the peanuts that increase crop hectarage in the ten percent solutions go into export. Even with the increased use of paddy for feed, chicken and beef are imported, while imported pork quantities are reduced in the two solutions.

Table 4.9 General Results. Comparison of Optimum Solutions of the Standard National Model with Models Which Constrain Capital

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-------Billion Piasters--------			Billion Piasters	
Farm Income	454.8	446.2	-2	389.4	-14
Consumers' Surplus	7.8	7.4	-5	7.4	-5
Total	462.6	453.6	-2	396.8	-14
Annual Foreign Exchange					
Commodity Export	39.3	40.2	2	31.0	-21
Commodity Import	46.0	64.3	40	88.4	92
Annual Inputs	37.3	33.8	-9	31.6	-15
Imports	83.3	98.1	18	120.0	44
Annual Balance	-43.9	-57.8	32	-89.1	103
Capital Investment (One-Time Requirement)					
Production	41.4	11.8	-72	2.4	-94
Distribution	25.8	21.8	-16	4.3	-83
Total	67.2	33.6	-50	6.7	-90
Foreign Exchange	45.6	19.3	-58	4.2	-91

Table 4.9 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons------			Thousand Metric Tons	
Exports					
Rice	0	0		0	
Corn	0	0		0	
Sorghum	0	0		0	
Soybeans	0	0		0	
Peanuts				168.5	
Peanut Oil	0	0		0	
Rubber	167.9	167.9		41.9	-75
Tea	.7				
Coffee	2.7	2.7		4.8	78
Coconut Meal	8.6	2.2	-74		
Copra	28.9	47.0	63	53.3	84
Pineapple				80.0	
Bananas	200.0	200.0		200.0	
Wheat Bran				35.5	
Duck Feathers	.9	.9		.9	
Pork	0	0		0	
Chicken	0	0		0	
Duck	2.0	2.0		2.0	
Chicken Eggs	1.1	1.1		1.1	
Molasses	14.3	8.7	-39	8.7	-39

Table 4.9 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons------			Thousand Metric Tons	
Imports					
Rice		207.4		510.0	
Corn	16.4				
Soybean Meal	45.2	18.8	-58	23.0	-49
Soybean Oil				35.3	
Raw Sugar	290.0	290.0		290.0	
Sugar	96.0	115.4	20	115.4	20
Jute		1.3		6.6	
Flour	107.1	107.1		107.1	
Wheat	185.9	185.9		185.9	
Cotton	39.4	39.4		39.4	
Pork	10.0	7.4	-26	5.9	-41
Chicken		5.8		5.8	
Beef		14.4		19.1	
	-------Thousand Hectares-------			Thousand Hectares	
Crop					
Rice, Non-Floating	1804.8	1995.3	11	2176.9	21
Rice, HYV	1399.5	1248.8	-11	1231.7	-12
Rice, Floating	838.2	656.3	-22	595.6	-29
Corn	87.6	69.9	-20	47.3	-46
Sorghum	349.8	348.7		138.9	-60
Soybeans	0	0		0	

Table 4.9 = continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-------Thousand Hectares-------			Thousand Hectares	
Crops (cont.)					
Peanuts	67.3	88.2	31	143.8	114
Sugarcane	4.4				
Tobacco	20.2	22.4	11	23.5	16
Rubber	140.0	140.0		38.5	-73
Tea	7.5	6.6	-12	6.6	-12
Coffee	7.0	7.0		10.5	50
Coconut	40.0	40.0		40.0	
Pineapple				10.0	
Bananas	8.4	8.2	-2	8.2	-2
Jute	11.1	9.8	-12	3.9	-65
Kenaf				.6	
Delta Crops					
Rice, Non-Floating	1161.6	1336.3	15	1415.7	22
Rice, HYV	905.5	808.6	-11	802.3	-11
Rice, Floating	838.2	656.3	-22	595.6	-29
Sorghum	178.0	178.0		52.1	-71
Peanuts	7.0	7.0			
Tobacco	10.0	15.7	57	4.0	-60
Coconut	40.0	40.0		40.0	
Pineapple	0	0		0	
Bananas	4.8	6.4	33	6.4	33
Jute	0	0		0	
Kenaf	0	0		0	

Table 4.9 - continued

Table 4.9 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-------Thousand Hectares-------			Thousand Hectares	
Eastern Crops					
Rice	223.3	230.4	3	227.2	2
Rice, HYV	199.9	159.9	-29	159.9	-20
Corn	16.0	13.9	-13	76.1	1
Sorghum	0	0		0	
Soybeans	0	0		9	
Peanuts	10.7	12.8	20	68.9	544
Sugarcane	0	0		0	
Tobacco	10.3	6.7	35	19.6	90
Rubber	120.0	120.0		38.5	-68
Coffee				3.5	
Pineapple				10.0	
Bananas	3.6	1.8	-50	1.8	-50
Jute	0	0		0	
Lower Coastal Crops					
Rice	104.5	104.5		106.2	2
Rice, HYV	91.8	91.8		66.2	-28
Corn	2.4	2.4		5.1	113
Sorghum	17.7	15.1	-15	10.7	-40
Soybeans	0	0		0	
Peanuts	4.8	7.5	56	7.5	56
Jute	.7	.7		.7	

Table 4.9 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-------Thousand Hectares-------			Thousand Hectares	
Central Coastal Crops					
Rice	146.3	153.9	5	179.6	23
Rice, HYV	101.0	109.4	7	117.8	16
Corn	2.3	4.6	100	4.6	100
Sorghum	61.7	66.1	7	32.1	-48
Peanuts	10.8	5.4	-50	4.8	-56
Sugarcane	4.4				
Jute	5.1	5.1		3.2	-37
North Coastal Crops					
Rice	134.2	135.5	1	154.9	15
Rice, HYV	65.7	65.7		65.7	
Corn	21.1	21.1		21.1	
Sorghum	86.6	83.8	-3	44.0	-49
Peanuts	7.9	10.7	35	23.5	198
Jute	5.3	4.0	-25		
Highland Crops					
Rice	34.7	34.7		93.3	169
Rice, HYV	34.7	13.4	-61	19.6	-43
Corn	45.8	27.9	-39	.4	-99
Sorghum	5.8	5.8			

Table 4.9 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-------Thousand Hectares-------			Thousand Hectares	
Highland Crops (cont.)					
Soybeans	0	0		0	
Peanuts	26.1	44.9	72	39.1	50
Rubber	20.0	20.0			
Tea	7.5	6.6	-12	6.6	-12
Coffee	7.0	7.0		7.0	

Table 4.10 National Crop Production. Comparison of Optimum Solutions of the Standard National Model with Models Which Constrain Capital

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Metric Tons------			Thousand Metric Tons	
Paddy Marketed	3419.6	3037.9	-11	2509.0	-27
Paddy Home Use	3328.8	3345.5	1	3394.4	2
Paddy Fed	569.1	749.0	32	1315.5	131
Total Paddy	7317.5	7132.4	-3	7218.9	-1
Rice Fed	0	0		0	
Corn Marketed	86.3	58.6	-32	29.4	-66
Corn Home Fed	100.7	81.5	-19	61.4	-39
Total Corn	187.0	140.2	-25	90.8	-51
Sorghum Marketed	150.6	150.0	-1	50.3	-67
Sorghum Home Fed	351.4	351.4		162.6	-54
Total Sorghum	502.0	501.4	-1	212.9	-58
Soybeans	0	0		0	
Peanut	119.0	156.3	31	233.4	96
Sugarcane	220.0				
Tobacco	25.9	25.9		25.9	
Rubber	176.0	176.0		50.0	
Tea	6.6	5.9	-11	5.9	-11
Coffee	8.4	8.4		10.5	25

Table 4.10 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Metric Tons------			Thousand Metric Tons	
Coconut	480.0	480.0		480.0	
Pineapple				80.0	
Bananas	208.9	204.4	-2	204.4	-2
Jute	11.1	9.8	-12	3.9	-65
Kenaf	0	0		0	

Table 4.11 New Facility Requirement. Comparison of Optimum Solutions of the Standard National Model with Models Which Constrain Capital

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Tobacco Processing					
East	.5	.5		.5	
Banana Marketing					
Delta	2.0	2.7	35	2.7	35
East	1.3	.7	-46	.7	-46
Fiber Processing					
East	2.6	2.1	-19		
Rubber Processing					
East	106.0	106.0		106.0	
Highland	20.0	20.0			
Tea Processing					
Highland	4.3	1.7	-61	1.7	-61
Rice Mill					
East	0	0		0	
Lower Coast	7.2	3.8	-47		
Highland	3.0				

Table 4.11 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Rice Drying					
Delta	52.1	52.6	1	36.6	-30
East	12.1	12.1		12.1	
Grain Storage					
Delta	280.4	205.4	-27	37.3	-87
East	0	0		0	
Lower Coast	0	0		0	
Highland	26.5	10.6	-60		
Threshing-Shelling					
Delta	194.2	194.2		56.8	-71
East	17.4	14.9	-14	20.0	15
Lower Coast	27.9	24.1	-14	18.9	-32
Central Coast	94.0	101.7	8	50.6	-46
North Coast	136.8	133.0	-3	73.4	-46
Highland	64.4	41.3	-36	.5	-99
Feed Mill					
Delta	2.8	.6	-79	.5	-82
Lower Coast	1.0	.6	-40	.6	-40
Central Coast	1.4	.6	-57	.2	-86

Table 4.11 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Feed Mill (cont.)					
North Coast	2.9	1.3	-55	1.0	-66
Highland	5.9	4.2	-29	.4	-93
Oil Mill					
Delta	.7	.3	-57		
East	.3	.4	33		
Lower Coast	.1	.2	100		
Central Coast	.3	.1	-67		
North Coast	.2	.3	50		
Highland	.8	1.4	75	.8	
Sugar Mill					
East	0	0		0	
Sugar Refinery					
East	0	0		0	
Central Coast	.2				

Table 4.12 Livestock and Livestock Products. Comparison of Optimum Solutions of the Standard National Model with Models Which Constrain Capital

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Metric Tons-------			Thousand Metric Tons	
Pork[a]					
Delta	178.1	182.7	-3	198.9	12
Eastern	60.2	65.1	8	80.6	34
Lower	17.5	20.2	15	20.2	15
Central	31.5	32.5	3	21.9	-31
North	39.5	38.2	-3	26.0	-34
Highland	27.0	19.1	-29	12.7	-53
Vietnam	353.7	357.8	1	360.2	2
Chicken[a]					
Delta	52.4	52.4		52.4	
Eastern	19.3	19.3		19.3	
Lower	3.8	3.8		3.8	
Central	7.1	5.9	-20	5.9	-20
North	13.3	6.3	-111	6.3	-111
Highland	2.7	2.5	-7	2.5	-7
Vietnam	98.5	90.2	9	90.2	9
Duck[a]					
Delta	44.3	44.3		44.2	
Eastern	6.7	6.7		6.7	
Lower	1.9	1.9		1.9	
Central	2.1	2.1		2.1	

Table 4.12 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Metric Tons-------			Thousand Metric Tons	
Duck[a] (cont.)					
North	1.9	1.9		1.9	
Highland	.2	.2		.2	
Vietnam	57.0	57.1	.2	57.1	
Chicken Egg					
Delta	20.8	20.8		20.8	
Eastern	10.4	10.4		10.4	
Lower	1.9	1.9		1.9	
Central	2.9	2.9		2.9	
North	3.1	3.1		3.1	
Highland	1.5	1.5		1.5	
Duck Egg					
Delta	9.6	9.7	1	9.8	2
Eastern	.2	.2		.2	
Lower	.7	.7		.6	-14
Central	.9	.9		.9	
North	.8	.8		.8	
Highland	.1	0.0		0.0	
Vietnam	12.3	12.3		12.3	

Table 4.12 - continued

Item	Optimum Solution of the Standard National Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Metric Tons-------			Thousand Metric Tons	
Beef[a]					
Delta	32.1	27.5	-14	19.1	-41
Eastern	23.9	8.1	-66	8.1	-66
Lower	6.4	6.2	-3	6.2	-3
Central	9.3	9.3		9.3	
North	10.0	5.8	-42	5.8	-42
Highland	4.4	3.1	-30	3.1	-30
Vietnam	86.2	60.0	-30	51.5	-40

[a]Live weight.

Summary

Restrictions on the availability of capital does not permit self-sufficiency in rice and livestock. A very large agricultural trade deficit will exist unless capital is expanded beyond 50 percent and 10 percent of optimum (unconstrained) capital requirements. Thus, capital constraints have a substantial impact on the agricultural economy of South Vietnam.

Comparison of the Results of the Geographically Reduced Model with Models Which Constrain Capital

If South Vietnam is assumed to consist of only the Delta region plus one half of the Eastern Region, total cropland is reduced 26 percent from the national standard model. The 50 percent and 10 percent of capital situations for this reduced region are examined and compared with the results of the reduced model without a capital constraint.

Total income is reduced slightly or -1.7 billion piasters (-1 percent) and -8.1 billion piasters (-4 percent) in the 50 percent and 10 percent of capital constraint solutions, respectively (Table 4.13).

Cropland

With the 50 percent of capital constraint (Table 4.13) total cropland is decreased 235,100 hectares (-7 percent), when compared with the reduced model. Reduction of total rice land is 251,900 hectares (-8 percent). An aggregate of 2,968,000 hectares is used for rice and 356,600 hectares for crops other than rice. Most of this other land is used for sorghum, rubber, and coconuts.

With the 10 percent of capital constraint (Table 4.13) total cropland is decreased -484,700 hectares (-14 percent). Reduction of total rice land is 380,200 hectares (-12 percent). The optimum resource allocation consists of 2,939,700 hectares of rice land and 235,300 hectares used for crops other than rice. Most of this other land is used for sorghum, rubber, and coconuts. In the 50 percent and 10 percent of capital constraint solutions, rice production changes are due to shifts from high-yielding varieties to traditional varieties of rice, because traditional rice varieties need less capital. Slight reductions in rice hectarages are replaced by peanuts in most regions. Basically, however, the agriculture continues to center around rice production. With the 50 percent capital constraint corn and jute areas are decreased. Corn and pineapple areas are increased, whereas sorghum, rubber, and jute areas decreased with the 10 percent of capital constraint. Peanuts, sugarcane, tobacco, and coconut hectarage increased nearly at the same rate in both solutions, the 50 percent and 10 percent of capital constraints. Soybeans come into optimum solutions of the reduced model and the 50 percent of capital constraint model with small hectarages (1,100 hectares). Tea and coffee production go out of the reduced model and capital constraint solutions. The sugarcane crop area increases 4,400 hectares in the 50 percent and 10 percent of capital constraints.

On a regional basis (Table 4.13), sorghum hectarage is quite large in the Delta region, and while corn comes into the Eastern region with relatively small hectarage. Sugarcane and rubber enter the optimum solution only in the Eastern region. No sugar mills or sugar refineries exist in the three solutions. Raw sugar is imported. Since the peanut

is an enterprise with high labor requirements, the peanut area increased about 5,300 hectares (76 percent) in the Delta region under the 50 percent of capital constraint solution and remained the same as the reduced model in 10 percent of capital constraint. In the Eastern region peanut hectarage remained the same area with the 50 percent capital constraint and increased 5,800 hectares (66 percent) with the 10 percent of capital constraint. Rubber maintained an important role in all three solutions (reduced model and the two capital constraints models).

In the Delta region (Table 4.13), non-floating rice and floating rice areas decreased approximately the same rate under both capital constraints, whereas the HYV rice area decreased 191,000 hectares (-22 percent) and 312,200 hectares (-36 percent), respectively, for the 50 percent and 10 percent of capital constraint solutions. Total rice land is reduced 207,800 hectares (-7 percent) and 321,700 hectares (-11 percent) for the 50 percent and 10 percent of capital constraint solutions, respectively. In this region, sorghum and tobacco areas are reduced drastically in the 10 percent of capital constraint solution. The peanut and tobacco areas are increased in the 50 percent of capital constraint solution. The coconut areas are increased 25 percent in both capital constraint solutions when compared with the reduced model. Pineapples come into the solution of the 10 percent of capital constraint with relatively small hectarage (5,000 hectares). Jute also comes into these two solutions with a small area (1,500 hectares).

In the Eastern region (Table 4.13), non-HYV rice areas are decreased 4,200 hectares (-2 percent) and 12,600 hectares (-6 percent), whereas HYV rice areas are decreased 39,900 hectares (-27 percent) and 45,900 hectares (-31 percent) for the 50 percent and 10 percent of capital

constraints, respectively. The total rice land area is reduced 44,100 hectares (-13 percent) and 58,500 hectares (-17 percent), respectively, for the two capital constraint solutions. In this region, tobacco decreased slightly in the 50 percent capital constraint solution while rubber decreased in the 10 percent of capital constraint solution. Jute decreased slightly in both capital constraint solutions. Sugarcane increased considerably in the 50 percent and 10 percent of capital constraint solutions. Corn decreased in the 50 percent of capital solution and increased slightly in the 10 percent of capital constraint solution. Sorghum does not enter into any solutions in the Eastern area. Soybeans come into the reduced model and the 50 percent of capital constraint solutions, while they disappear from the 10 percent of capital constraint solution.

In summary, with the 50 percent capital constraint in the Delta region there are shifts of rice land to peanuts, tobacco, and coconuts, while in the Eastern region there are some shifts from corn, tobacco, and jute to sugarcane. With the 10 percent of capital constraint some rice, sorghum, tobacco and jute cropland in the Delta region goes out of solution and some shifts from rice, rubber, jute crops to corn, peanuts, sugarcane, and tobacco crops occur in the Eastern region.

Production

Total paddy production declined only slightly with each increment of capital reduction. Total paddy is decreased about 318,700 M.T. (-5 percent) and 480,200 M.T. (-8 percent) for 50 percent and 10 percent of capital constraints, respectively. However, an increase of paddy fed to livestock is associated with a reduction of capital. Paddy fed to livestock increases 219,500 M.T. (36 percent) and 404,100 M.T. (65 percent),

respectively, for the two capital constraint solutions. Paddy production of the reduced model and the 50 percent of capital constraint solution largely satisfy domestic consumption requirements (Table 4.14).

With the 50 percent capital constraint there is no change in the distribution of livestock production compared with the reduced model, except for hogs and beef (Table 4.16). Total pork production is unchanged, but there is a shift of pork production from the Eastern to the Delta region because pork production tends to move toward feed supplies. Eastern pork production is reduced -10,700 M.T. (-1 percent) and Delta pork production is increased 10,700 M.T. (6 percent). Total beef production is decreased -1,600 M.T. (-5 percent). Eastern beef production remains constant and Delta beef production is decreased -6,900 M.T. (-6 percent). With the 10 percent of capital constraint, there is no change in total livestock production except for chicken and beef. Some shift in production from the Eastern to the Delta region occurs to coincide with changes in feed supplies. With the 50 percent and 10 percent of capital constraints the existing commercial hog optimum remains the same as in the reduced model. Small commercial hog production, which exists in the reduced model, disappears in the solutions for the 50 percent and 10 percent of capital constraints. Delta and Eastern farm (home) hog enterprises increased slightly or 219,388 head (7 percent) for both capital constraint solutions compared with the reduced model. Poultry production changes very little when capital is reduced to 50 percent and 10 percent of capital available in the reduced model. No small-scale (farm) commercial poultry enterprises are included as alternative enterprise possibilities in these three solutions (reduced, 50 percent, 10 percent solutions). Existing large-scale commercial swine and poultry enterprises are fixed in the various regions. Imported cattle and buffalo are reduced -4476

(-18 percent) and diminished to 0 in the 50 percent and 10 percent of capital constraints, respectively. Cattle and buffalo in the Eastern region are the same for the three solutions.

Capital, Facilities, and Foreign Trade

With the 50 percent and 10 percent of capital constraint solutions, capital investments (Table 4.13) are reduced 14.5 billion piasters (-50 percent) and 26.1 billion piasters (-90 percent), by definition. New capital investments decrease and requirements for foreign exchange decrease too. Foreign exchange decreases -9.9 billion piasters (-52 percent) and -17.8 billion piasters (-93 percent) for 50 percent and 10 percent of capital constraints. With the 50 percent of capital constraint, capital for production facilities is reduced -8.1 billion piasters (-68 percent) and capital for distribution facilities is reduced -6.4 billion piasters (-37 percent). With the 10 percent of capital constraint, capital for production facilities is reduced to 0. Capital for distribution facilities is reduced about -14.2 billion piasters (-83 percent).

Sprayers and pumps required in the Delta, Easter, and Highland regions are reduced -1045 (-26 percent) and 865 (-28 percent), respectively, in 50 percent of capital constraints. Sprayers and pumps required in the Delta, Eastern, and Highland regions are reduced -1715 (-42 percent) and 1609 (-52 percent) for the 10 percent of capital constraint. Importation of additional work stock and new tools is reduced in the 50 percent and 10 percent of capital constraints. Existing tractors, cattle, and buffalo are fixed in all three models (reduced, 50 percent and 10 percent) according to their regional

distribution in 1973. For additional power requirements, the reduced model and the 50 percent of capital constraint model suggest importing additional livestock. Cattle imported for this purpose represent a one-time investment and foreign exchange requirement. Additional livestock numbers supply beef as well as power. With the 10 percent of capital constraint solution, there is no additional power requirement because no capital is available for production facilities. With the 50 percent of capital constraint, the additional livestock are imported into the Delta region. All solutions in the analysis import cattle for power needs in preference to tractors. The reduced model imports 24,284 cattle, while 19,808 cattle are imported for the 50 percent capital constraint. In the 50 percent of capital constraint imported livestock numbers are reduced about 4477 cattle (-18 percent) compared with the reduced model. Thus, beef production is decreased and there is an increase in imported beef products.

Grain storage, rubber processing and oil milling are the major items requiring new facility capital with capital constrained 50 percent. Rice drying and rubber processing are the major items requiring new capital investment for the 10 percent of capital constraint solution (Table 4.15).

Trade deficits of the reduced model and the related capital constraint solutions are relatively small (Table 4.13) compared with standard solutions presented in earlier sections. This difference results primarily from the relative significance of rice exports. The annual trade deficit of the reduced model is -1.2 billion piasters or about 97 percent less than the trade deficit of the standard model. Trade deficits for the 50 percent and 10 percent of capital constraint

solutions are larger than for the reduced model because of reduced rice exports and increased beef imports. With the 50 percent of capital constraint the solution still permits self-sufficiency in rice, chicken, and pork. Rice exports decrease in the 50 percent and 10 percent of capital constraint solutions because of increased paddy fed to livestock and reduced rice production as capital investment decreases. Rice and bananas are the significant export items in reduced model. These two commodities are still the most important export items in the 50 percent of capital constraint solution with a reduction of exported rice of -55 percent and coconut meal exports reduced about -14 percent. Copra exports increase about 18,500 M.T. (135 percent). Sorghum comes into the export solution for the first time with 10,800 M.T. With the 10 percent of capital constraint, there are still other changes in commodity exports. Compared with the reduced model, rice exports are reduced about -522,000 M.T. (-97 percent). Bananas and pineapple are the significant exports in the 10 percent of capital constraint solution. Rubber exports are reduced slightly or -10 percent. Copra and pineapple exports are increased drastically or 53,000 M.T. and 40,000 M.T., respectively. Peanut exports come into the solution with 35,700 M.T. Pork, chicken and duck are exported with similar and small quantities for all three model solutions. The value of commodities exported is decreased -14.2 billion piasters (-26 percent) and 23.3 billion piasters (-43 percent) for the 50 percent and 10 percent of capital constraint solutions, respectively. The value of imports for commodities is decreased about 5.4 billion piasters (-10 percent) and 1.8 billion piasters (-3 percent), respectively. Raw sugar and flour are the most important items imported in the 50 percent and 10 percent of capital constraint

solutions. Sugarcane comes into the reduced model and the capital constraint solutions with a small area. Therefore, raw sugar is imported into these three solutions. Soybeans come into the reduced model and the 50 percent capital constraint solutions with a small crop area of 1,100 hectares. Therefore, soybeans are imported in these three solutions. Soybean oil is imported at the rate of 32,000 M.T. in the 10 percent of capital constraint solution. Wheat is imported in small quantity in the 10 percent of capital constraint solution (Table 4.13).

Pork and chicken are not imported in the three solutions, but beef is imported in each. Beef imports are increased because of reduced beef production and less work stock cattle and buffalo as capital is reduced.

Table 4.13 General Results. Comparison of Optimum Solutions of the Reduced Model with Models Which Constrain Capital

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Billion Piasters-------			Billion Piasters	
Farm Income	195.4	201.8	3.3	195.4	
Consumers' Surplus	31.7	23.6	-25.5	23.6	-25.6
Total	227.1	225.4	-.8	219.0	-3.6
Annual Foreign Exchange					
Commodity Export	54.4	40.2	-26.1	31.1	-42.8
Commodity Import	31.1	29.0	-6.8	34.5	11.0
Annual Inputs	24.5	21.2	-13.5	19.3	-21.2
Imports	55.6	50.2	-9.7	53.8	-3.2
Annual Balance	-1.2	10.0	733.3	22.7	1791.0
Capital Investment					
Production	11.9	3.8	-68.1	0.0	
Distribution	17.1	10.7	-37.4	2.9	-83.0
Total	29.0	14.5	-50.0	2.9	-90.0
Foreign Exchange	19.1	9.2	-51.8	1.3	-93.2
Exports					
Rice	537.2	243.7	-54.6	15.2	-97.2
Corn	0	0		0	

Table 4.13 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Billion Piasters-------			Billion Piasters	
Exports (cont.)					
Sorghum		10.8			
Soybeans	0	0		0	
Peanuts				35.7	
Peanut Oil	0	0		0	
Rubber	75.3	75.3		67.7	-10.1
Tea	0	0		0	
Coffee	0	0		0	
Coconut Meal	13.9	12.0	-13.7		
Copra	13.7	32.2	135.0	66.7	386.9
Pineapple	80.0	80.0		120.0	50.0
Bananas	200.0	200.0		200.0	
Wheat Bran	0	0		0	
Duck Feathers	.9	.8	-11.1	.8	-11.1
Pork	5.0	5.0		5.0	
Chicken	1.3	1.3		1.3	
Duck	5.0	5.0		5.0	
Chicken Eggs	1.1	1.1		1.1	
	----Thousand Metric Tons-----			Thousand Metric Tons	
Imports					
Rice	0	0		0	
Corn	0	0		0	
Soybean Meal	34.2	16.2	-52.6	29.5	-13.7

Table 4.13 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----Thousand Metric Tons-----			Thousand Metric Tons	
Imports (cont.)					
Soybean Oil				32.0	
Raw Sugar	252.4	225.7	-10.6	225.7	-10.6
Sugar	0	0		0	
Jute	1.2	2.1	75.0	2.7	125.0
Flour	20.8	160.2	670.0	157.8	658.7
Wheat	185.9			3.3	-98.2
Cotton	25.6	25.6		25.6	
Pork	0	0		0	
Chicken	0	0		0	
Beef	11.2	12.0	7.1	15.8	41.1
	------Thousand Hectares------			Thousand Hectares	
Crops					
Rice, Non-Floating	1546.0	1585.7	2.6	1583.6	2.4
Rice, HYV	1017.6	786.7	-22.7	660.5	-35.1
Rice, Floating	656.3	595.6	-9.3	595.6	-9.3
Corn	4.2	1.6	-61.9	5.0	19.1
Sorghum	178.0	178.0		54.5	-69.4
Soybeans	1.1	1.1			
Peanuts	15.8	21.1	33.5	21.6	36.7
Sugarcane	1.8	6.2	244.4	6.2	244.4
Tobacco	12.6	13.2	4.8	13.8	9.5
Rubber	62.0	62.0		56.1	-9.5

Table 4.13 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Hectares------			Thousand Hectares	
Crops (cont.)					
Tea	0	0		0	
Coffee	0	0		0	
Coconut	40.0	50.0	25.0	50.0	25.0
Pineapple	10.0	10.0		15.0	50.0
Bananas	8.6	8.6		8.6	
Jute	5.7	4.8	-15.8	4.5	-21.1
Kenaf	.4	.3	-25.0		
Delta Crops					
Rice, Non-Floating	1346.3	1390.2	3.3	1396.5	3.7
Rice, HYV	870.7	679.7	-22.0	559.5	-35.7
Rice, Floating	656.3	595.6	-9.3	595.6	-9.3
Sorghum	178.0	178.0		54.5	-69.4
Peanuts	7.0	12.3	75.7	7.0	
Tobacco	7.9	9.3	17.7	3.9	-50.6
Coconut	40.0	50.0	25.0	50.0	25.0
Pineapple				5.0	
Bananas	2.5	2.5		2.5	
Jute	1.5	1.5		1.1	-26.7
Eastern Crops					
Rice	199.7	195.5	-2.0	187.1	-6.4
Rice, HYV	146.9	107.0	-27.2	101.0	-31.3

Table 4.13 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	------Thousand Hectares------			Thousand Hectares	
Eastern Crops (cont.)					
Corn	4.2	1.6	-62.0	5.0	19.1
Sorghum	0	0		0	
Soybeans	1.1	1.1			
Peanuts	8.8	8.8		14.6	66.0
Sugarcane	1.8	6.2	244.4	6.2	244.4
Tobacco	4.7	3.9	-17.0	9.9	110.6
Rubber	62.0	62.0		56.1	-9.5
Coffee	0	0		0	
Pineapple	10.0	10.0		10.0	
Bananas	6.1	6.1		6.1	
Jute	4.2	3.3	-21.4	3.3	-21.4

Table 4.14 National Crop Production. Comparison of Optimum Solutions of the Reduced Model with Models Which Constrain Capital

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons-----			Thousand Metric Tons	
Paddy Marketed	3048.9	2510.7	-17.7	2164.6	-29.0
Paddy Home Use	2330.7	2330.7		2330.7	
Paddy Fed	618.2	837.7	35.5	1022.3	65.4
Total Paddy	5997.8	679.1	-5.3	5517.6	-8.0
Rice Fed				72.3	
Corn Marketed	4.3	1.5	-65.1	5.4	25.6
Corn Home Fed	3.9	1.4	-64.1	4.9	25.6
Total Corn	8.2	2.9	-64.6	10.3	25.6
Sorghum Marketed	116.5	116.5		35.7	-69.4
Sorghum Home Fed	97.1	97.1		29.7	-69.4
Total Sorghum	213.6	213.6		65.4	-69.4
Soybeans	1.4	1.4			
Peanuts	27.7	38.3	38.3	39.3	41.9
Sugarcane	146.0	440.0	201.4	440.0	201.4
Tobacco	16.8	16.8		16.8	
Rubber	80.5	80.5		73.0	9.3
Tea	0	0		0	
Coffee	0	0		0	

Table 4.14 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons-----			Thousand Metric Tons	
Coconut	480.0	600.0	25.0	600.0	25.0
Pineapple	80.0	80.0		120.0	50.0
Bananas	215.3	215.3		215.3	
Jute	5.7	4.8	-15.8	4.5	-21.1
Kenaf	.4	.3	-25.0		

Table 4.15 New Facility Requirement. Comparison of Optimum Solutions of the Reduced Model with Models Which Constrain Capital

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Tobacco Processing					
East	0	0		0	
Banana Marketing					
Delta	1.0	1.0		1.0	
East	2.3	2.3		2.3	
Fiber Processing					
East	.6	.3			
Rubber Processing					
East	30.5	30.5		23.0	-24.6
Highland	0	0		0	
Tea Processing					
Highland	0	0		0	
Rice Mill					
East	0	0		0	
Lower Coast	0	0		0	
Highland	0	0		0	

Table 4.15 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Rice Mill (cont.)					
Rice Drying	0	0		0	
Delta	52.6	51.7	-1.7	30.5	-42.0
East	12.1	8.6	-29.0	6.0	-50.4
Grain Storage					
Delta	232.0	101.5	-56.3		
East	0	0		0	
Lower Coast	0	0		0	
Highland	0	0		0	
Threshing-Shelling					
Delta	194.2	194.2		59.4	-69.4
East	3.9	1.4	-64.1	4.9	25.6
Lower Coast	0	0		0	
Central Coast	0	0		0	
North Coast	0	0		0	
Highland	0	0		0	
Feed Mill					
Delta	1.4	.5	-64.3	.5	-64.3
Lower Coast	0	0		0	
Central Coast	0	0		0	

Table 4.15 - continued

Table	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	----------Units----------			Units	
Feed Mill (cont.)					
North Coast	0	0		0	
Highland	0	0		0	
Oil Mill					
Delta	1.1	1.1			
East	.3	.3			
Lower Coast	0	0		0	
Central Coast	0	0		0	
North Coast	0	0		0	
Highland	0	0		0	
Sugar Mill					
East	0	0		0	
Sugar Refinery					
East	0	0		0	
Central Coast	0	0		0	

Table 4.16 Livestock and Livestock Products. Comparison of Optimum Solutions of the Reduced Model with Models Which Constrain Capital

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons------			Thousand Metric Tons	
Pork[a]					
Delta	188.2	198.9	6.0	198.9	6.0
Eastern	59.8	49.1	-18.0	49.1	-18.0
Lower	0	0		0	
Central	0	0		0	
North	0	0		0	
Highland	0	0		0	
Vietnam	248.0	248.0		248.0	
Chicken[a]					
Delta	52.4	52.4		52.4	
Eastern	13.5	13.5		12.6	-7.0
Lower	0	0		0	
Central	0	0		0	
North	0	0		0	
Highland	0	0		0	
Vietnam	65.9	65.9		65.9	-1.0
Duck[a]					
Delta	35.7	35.7		42.4	19.0
Eastern	6.7	6.7		0	
Lower	0	0		0	
Central	0	0		0	

Table 4.16 - continued

	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons------			Thousand Metric Tons	
Duck[a] (cont.)					
North	0	0		0	
Highland	0	0		0	
Vietnam	42.4	42.4		42.4	
Chicken Egg					
Delta	18.6	18.6		19.0	2.0
Eastern	8.1	8.1		7.7	-5.0
Lower	0	0		0	
Central	0	0		0	
North	0	0		0	
Highland	0	0		0	
Duck Egg					
Delta	7.8	7.8		8.0	2.6
Eastern	.2	.2		0	
Lower	0	0		0	
Central	0	0		0	
North	0	0		0	
Highland	0	0		0	
Vietnam	8.0	8.0		8.0	

Table 4.16 - continued

Item	Optimum Solution of the Reduced Model	50 Percent of Optimum Capital	Percent Change	10 Percent of Optimum Capital	Percent Change
	-----Thousand Metric Tons------			Thousand Metric Tons	
Beef[a]					
Delta	27.6	26.0	-5.8	19.1	-30.8
Eastern	8.1	8.1			
Lower	0	0		0	
Central	0	0		0	
North	0	0		0	
Highland	0	0		0	
Vietnam	35.7	34.1	-4.5	27.2	-23.8

[a]Live Weight.

CHAPTER V
SUMMARY AND CONCLUSIONS

Improvement of agricultural production and income is closely tied to the increased use of capital. Farm income is the sum of the returns to physical capital (land, buildings, machinery), physical family labor, and human capital. One of the reasons for the relatively high percentage of low income farms in Vietnam is their small stock of physical capital. Therefore, this study tried to evaluate the capital needs and effects of the agricultural sector of Vietnam. The objectives of this study are to investigate the productive capacity of South Vietnam's agriculture so as to maximize national agricultural income, specify resources, and define production relationships among resources, enterprises, and regions, plus determining the requirements for processing and marketing facilities. Optimum capital investments are generated in connection with the standard national model and the reduced model. Computer runs were made with capital constraints at 50 percent and 10 percent of optimum levels generated. A comparison of these optimum solutions was made.

Linear programming was the tool used for analyzing the problem by utilizing 1973 prices of inputs and commodities. The study determined the optimum combination of resources; evaluations were made regarding the particular capital constraints. Therefore, the approach of this

study is similar to parametric programming to maximize national agricultural income.

The solutions indicated that capital investment could be reduced considerably below optimum levels without appreciably affecting total agricultural income levels. But capital reductions do affect the balance of trade and production and distribution facilities.

Capital and credit in Vietnam agriculture represent an important aspect of the substantial adjustment and economic development problems facing Vietnam's agricultural sector. Since the postwar economy will remain primarily based on the agricultural sector, attention must be directed to possible means of generating capital for the resettlement of abandoned lands, to the development of new lands, and to manufacturing industries based upon agriculture. Credit in adequate amounts and on reasonable terms is one of the major facilitating factors in any effort to increase agricultural producton.

Summary of Results

This study consisted of the standard national model, six regional models (Delta, Eastern, Lower Coast, Central Coast, North Coast and Highlands regions), plus the geographically reduced model with only the Delta and one half of Eastern region. Capital constraints of 50 percent and 10 percent of optimum capital from these optimum solutions are imposed.

Capital constraints do have an impact upon rice production. In the standard national model, capital constraints reduced total paddy production. In the reduced model, capital constraints also reduced total paddy production and caused a substantial reduction in rice exports.

As capital investments decrease, the amount of paddy fed to livestock increases and marketed paddy decreases, while rice exports decrease. Paddy is substituted for some feed grain used for livestock. This paddy is harvested in the wet season. It is used as feed because of reduced drying facilities. Increased feeding, plus reduced paddy production, results in a reduction of rice exports as capital is constrained in the reduced model.

Corn and sorghum are the two main feed grain crops. Corn is relatively sensitive to reductions of capital. Sorghum, however, is insensitive as capital investments are reduced considerably below optimum levels. Sorghum is a supplementary crop in the floating rice areas. Sorghum almost always comes into all solutions on land of the floating rice area because it can be grown on residual moisture after the floating rice is harvested. There is no alternative use for the resources used and variable costs are more than covered by the value of the crop.

Soybeans come into the reduced model and its 50 percent capital constraint solution with small production quantities.

Peanuts are a major expansion crop on the historical land resource base as capital investments are reduced. Peanuts are the only crop for which lime requirements are specified at a separate level of technology. Most peanuts would be milled, primarily to obtain the meal.

Sugarcane production disappears in a relatively early stage of capital reduction in the standard national model and it is replaced by sorghum because the sorghum enterprise requires less capital. Sugarcane is not considered as a major enterprise alternative in Vietnam within the historical land resource base because sugarcane crops have historically occupied a small area. Sugarcane production does not occur on the better alluvial soils in Vietnam.

Tobacco production increases slightly as capital is reduced. It appears in all solutions to supply domestic consumption requirements. Moreover, tobacco would come into the solution for export if export of tobacco were permitted.

Rice, sorghum and rubber come into most optimum solutions on a large area basis. Rubber is not affected when capital is reduced considerably below optimum levels. Rubber would also come into the solution on a larger areas basis if permitted.

In the standard national model tea is affected slightly and negatively as capital is constrained. Coffee production, however, increases somewhat as capital is reduced. Tea and coffee do not come into the reduced model's optimum solutions.

Coconut production is insensitive to the capital constraints of the standard national model, but it does increase with capital limitations in the reduced model. This crop occurs on land with saline content. The coconut is exported in the form of copra and coconut meal. Exported copra shows important quantities and increases as capital is reduced, whereas exported coconut meal decreases and disappears in 10 percent capital constraint solutions of the complete and reduced models, respectively.

Pineapple output expands as capital is reduced.

Banana production is very slightly affected by capital reductions in the complete model. Exported bananas show great strength in all solutions. Banana production always occurs to the limit imposed by the export restriction in the reduced model and its capital constraint solutions. If no constraint is set up, much larger quantities of bananas would be produced. Banana production does not have a great

effect on competing scarce resources with the other activities because bananas use land intensively.

Jute is sensitive to capital restrictions. As capital investments are reduced, jute production is reduced. At the reduced production level, jute does not satisfy domestic consumption requirements and it is therefore imported.

Wheat bran comes into the 10 percent of capital constraint in the standard national model.

Duck feathers, duck, chicken eggs are exported in all solutions with small quantities. These items seem insensitive to capital reductions. These small quantities of duck and chicken eggs are not significant because they come from a small surplus of ducks and chickens that satisfy the duck and chicken egg consumption requirements.

There are no pork and chicken exports in the standard national model, whereas pork and chicken exports do appear in the reduced model and its capital constraint solutions with small and constant quantities.

Although feed supplies are sufficient, large scale commercial poultry and swine production is lacking, whereas large scale commercial duck production enters in every solution. Small scale farm commercial (SCM) hog enterprises, using family labor and very simple production methods, enter the solution of the standard national and reduced models. Production is reduced in the 50 percent capital constraint of the standard national model and disappears in the other capital constraint solutions (10 percent of capital constraint of the national model and the 50 percent and 10 percent capital constraint of the reduced model).

Cattle and buffalo work stock give power requirements as well as beef for food. Commercial beef cattle enterprises do not come into any

solution. Large scale beef enterprises cannot compete with crops for resources in areas with potential for crop production.

Importing cattle and buffalo for workstock provide power requirements in South Vietnam. The computer solutions do not imply full mechanization, but mechanization only for the portion that could not be handled with existing livestock. Full mechanization for power requirements at this stage of development will reduce agricultural income and increase the expenditure of foreign exchange. However, some mechanization requirements are needed for development in agriculture. For example, requirements for mechanization of threshing operations must be met. With complete mechanization, income and investment effects would be much larger. A reduction of capital did slow down the development of the country by reducing unit numbers of new facility requirements.

When capital investments are reduced, production and distribution facilities are also reduced. Therefore, total production and income decrease, exports decrease, while imports and the trade deficit increase. Most of the decreased output emanates from decreased rice production as capital is reduced. There are some shifts away from rice production on high-yielding rice, with movement to the non-floating rice area due to the pressure of capital reductions. But basically, the agriculture of Vietnam still continues to center around rice production.

The typical farm size in the Highland and Coastal regions is quite small (.5 hectare) or less than one half the average size of Delta farms. Pressure for rice production for subsistence in the Highland and Coastal regions is greater than on typical farms in the Delta and Eastern regions. With small units the effects on individual farm incomes is small from adjusting from a low yielding crop of rice to other crops even if these other crops give higher per hectare returns.

Rice is by far the most important agricultural commodity in Vietnam. It should be possible to produce sufficient rice for export in spite of the high local demand presented by Vietnam's increasing population. In order to obtain a balanced agricultural economy, not based on rice alone, diversified cropping of annual crops will likely assume a greater importance in the future. With the greater need for animal protein, the livestock industry will require feeds such as corn, sorghum and leguminous forage crops. Peanuts and soybeans will provide oil for humans and feeds for livestock.

The solutions of this study indicated that capital investment could be reduced considerably below optimum levels without appreciably affecting income levels. This does not mean that the capital factor is not important but that the historical land resource base (existing land plus the return of abandoned land) does not provide a basis for much economic development. Unless the land resource base is expanded or improved beyond its traditional limits, Vietnam can expect continued deficits in its balance of trade because trade balances are negative in all solutions. In the capital constraint solutions of the standard national model, the historical land resource base does not permit self-sufficiency in production of both rice and livestock. Rice is imported with great quantities. Imported chicken and beef come into these two constrained solutions. Imported pork quantities decreased as capital was reduced. In the reduced model, the capital constraint solutions permit self-sufficiency in production of both rice and livestock, except beef production, because the Delta region is highly productive. Imports were somewhat insensitive to reduced capital, except that imported beef and jute increased as capitals decreased.

Trade balances are negative unless the land resources base is expanded. The addition of previously cultivated unused land to the agricultural resource base results in a large increase in agricultural income and a large decrease in the agricultural trade deficit. From the historical land base and with adoption of improved technology, farmers can shift to income maximization. The adoption of new varieties is determined primarily by the profitability of the variety. Rice production will be maintained on the better rice land and will retain a dominant position in the economy. Vietnam will be self-sufficient in feed grains and feed grains will substitute for paddy rice as livestock feeds, releasing considerable quantity of rice for export. The productive potential of the historical land resources base could be increased through measures to improve water control, increase irrigation, and reduce the effect of salt water intrusion. These developments require large expenditures of public development capital. Most of the alluvial soils are now planted to rice, annual crops and fruit trees. The application of new techniques of production, plus water control, will greatly increase yields.

Concluding Remarks

It is obvious that South Vietnam's agriculture must be made more productive and that a major effort is required. First priority must go to increasing the output of those commodities already being produced in the country primarily for domestic consumption. Rice is among these items. Greater quantities of animal products are also needed. Next, commodities have been and still are exported in some volume. Prime examples of these products are rubber, coffee, bananas, tea, duck feathers, duck eggs and copra. These export commodities are important sources of foreign exchange and the trade channels for them are already

established. A third group of commodities which may have a production potential in Vietnam are cotton, wheat, kenaf, feed grains, grapes, and baby chicks as examples of such items. Some of these commodities have been produced in Vietnam on a very limited scale but there is need to explore more fully the possibilities of displacing these imports on a broad front, wherever it is considered economically feasible to do so. By reducing such imports Vietnam would save foreign exchange and also add to the national product by increasing the productivity of the agricultural sector. Finally, there should be constant attention to the search for new products that may have a potential for export or for use in country. On the basis of experience in other areas of the Far East, this category might include such items as processed cassava, palm oil, milk, seeds, processed fruits, citronella and mushrooms. Castor bean, cocoa and silk have also been suggested. Agricultural products may be economically desirable if this is defined as expanding total agricultural production so that the total value of agricultural exports exceeds the total value of agricultural imports.

To protect producers' interests and to stabilize prices, a rational price policy on agricultural products, especially on rice and necessities, needs to be enacted. Changes in national food policy should be accompanied by measures remodeling the procurement and distribution system. Import procedures of essential commodities not being produced domestically could be simplified and rationalized. In addition, import restrictions could be gradually abolished to ensure the normal functioning of the law of supply and demand in a climate of healthy competition. Exports will mostly be undertaken by the private sector with government support. The government would initiate a national movement to promote exports.

In view of this objective, and in order to avoid dependence on any particular market, entrepreneurs should be urged to strenghten their sales to existing international markets, as well as to study and enter new ones. Production processes could be improved and oriented toward exports by identifying those products with good prospects for export, by encouraging the diversification of export, notably processed commodities, and by adopting quality control procedures to standardize the Vietnamese products in order to help them compete in the international market. The government would give financial assistance to exporters by granting short-term credits with low interest rates and by allowing them maximum profits through favorable exchange rates and tax exemptions.

Price has a very strong bearing on both the production and marketing of agricultural crops. It has been amply demonstrated that farmers in less developed countries respond to price incentives just as they react to it in the more advanced areas. With the partial removal of price restrictions on pork in 1967, for example, there was a noticeable upturn in hog production in South Vietnam despite wartime impairment of feed supplies, labor, transportation, etc. Price problems are often difficult to solve. On the one hand, it is advisable to hold down the price paid by consumers, while on the other, it is hoped that farmers will increase their production. To reach the levels of production required to meet prospective needs for agricultural products, it seems obvious that there must be reasonable price incentive on all commodities. Price also plays a vital role in the export of agricultural products. The continuing inflation of prices in South Vietnam leads to a situation in which the local products are priced out of the international market under official rates of exchange. In such circumstances, barring further devaluation,

there is likely to be more and more demand for export subsidies or other special concessions aimed at bolstering the return from commodities shipped out of Vietnam. Exports of tea are now heavily subsidized and while this item alone is no serious drain on the public funds, the situation would be much different if a million tons of rice were involved, as may well be the case if domestic production increases markedly. Support prices, purchase programs, subsidies, import and export restrictions, and even price control, are among the measures often used to influence prices.

Increased financial support for more agricultural research and educational work is needed in Vietnam. Moreover, the agriculture industry, defined broadly to include marketing and processing of agricultural products and the supply of production requisites, should be given much higher priority than it now has in making allocations of scarce capital for development purposes. Small farm development is a problem of concern to policy makers in many countries of the world and of special concern to policy makers in South Vietnam. Indeed, capitalization of the agricultural sector is important for countries in the process of development. Introduction of capital into agriculture will greatly enhance the possibility of steady development and provide policy makers with a new useful policy measure to escape the trap of stagnation. In addition, the introduction of additional capital into agriculture is likely to infuse modern knowledge and spirit into what is frequently a traditionally oriented sector, thereby stimulating improvement in the quality of labor. If technical progress takes place with new capital, or if the increase in the efficiency of labor is accelerated by higher capital intensity, the introduction of capital into the agricultural sector becomes even more

important. Frequently farmers borrow from landlords, relatives and other individuals. In some instances, individuals are a satisfactory source of credit, providing easy access to funds on reasonable terms. Generally, however, individuals are not a highly dependable source of credit over a period of time. Publicly supported credit programs are considered as a vehicle for accelerating adoption of technological innovations by small farmers thereby accelerating the economic growth of small farms. However, the government does not wish to make agricultural progress in South Vietnam a give-away program. Through the Agricultural Development Bank and the rural banking system, farmers are able to invest in their own advancement, acquiring the seed, the animals and the equipment they need for modern farming. Until these credit facilities came to his village, the peasant could not experiment with new techniques. The money-lender was a man to shun except in the most dire emergencies, and the commercial banks were not interested in high-risk farm improvement loans without collateral. A gap was created that only the government could fill. The principal vehicle for implementing government agricultural policy has been the ADBV. Government agricultural programs are supported by special program funds administered by the ADBV. Adoption of modern production methods requires the use of purchased inputs such as chemical fertilizer, improved seed and insecticides. Government subsidizes fertilizer inputs through the exchange rate and does not impose taxes on imports. It pursues liberal import regulations with regard to the procurement of insecticides, livestock (swine) and seeds. In addition, the government supports the price of rice with a minimum guarantee set at VN $500 per 20 kilos and subsidizes tea exports (to be equivalent of VN $125 per US $1). Encouragement takes

the form of loans at low interest rates as well as technical assistance and supervision in the use of modern production technology. Suggestion for planning development can be divided into three main groupings. First, production projects involve a crops program. Secondly, support projects consist of rural engineering and irrigation, agricultural mechanization, the establishment of institutional organizations of farmers, agricultural extension, research and plant protection. Thirdly, there are food processing projects.

In summary, in order to achieve economic growth and become financially self-supporting, South Vietnam will need to produce more farm products to supply its rapidly growing population and to attain necessary export earnings for the importation of capital goods and raw materials. In order for agriculture to become the engine that stimulates this economic growth, ways must be found to economically increase agricultural output, income, and efficiency. Scarce resources must, of course, be used where they contribute most to national output. The farm value of agricultural products in South Vietnam represents more than one-third of the value of national production (gross national product). Experience has shown that a farmer's income depends to a large extent upon the amount of his farm products. Improvement of incomes, especially those of rural people, is a meritorious goal. Given the present situation in Vietnam, increases in production and income are closely tied to increased use of capital. Linear programming studies of the type performed with this research effort can provide a useful basis for suggesting ways to meet that often conflicting goal of increased agricultural production and income.

APPENDIX

The appendix elaborates the major assumptions and procedures used in this study. Some of these bear summarizing here. Among the major assumptions are:

1. That security will greatly improve and that the political and social climate will permit specified economic changes to occur;

2. That public and infrastructure developments implied by particular model solutions will be accomplished. These developments and their costs are not specified;

3. That internal capital requirements generated by particular solutions can be made available;

4. That the necessary distribution structure can be developed concurrent with production changes;

5. That labor will not be a limiting resource, particularly with improved security and a move toward relative peace;

6. That the small farm size structure will be retained;

7. That the farm family will provide most of the required labor on farms other than rice farms.

In addition to the assumptions and procedures described in the appendix, various other conditions and limits have been placed on the various optima. The purpose of such conditions is always to attempt to attain as much realism as possible. It is not always possible to state an objective reason for the precise quantitative condition imposed; in some instances it is based primarily on the intuition of the researcher. Some of the more significant conditions are:

1. Home livestock enterprises are not permitted to expand by more than 60 percent over the planning period. The precise figure of 60 percent might be questioned. Certainly there is a limit by which these enterprises can expand while providing output for consumption.

2. Rubber, coffee, and tea production on old land is limited to the approximate maximum area that these crops occupied in the past, by region.

3. New pineapple production (above that which is expected to occur on excluded land) is limited to 15,000 hectares (ha). There is considerable question about export markets for large quantities of pineapple. Without this limitation, pineapple would be produced in far greater quantity in many solutions.

4. A rotation requirement is imposed on peanuts, limiting this crop to not more than 50 percent of a given land resource.

5. Within given land resources, jute and kenaf are limited to 5-10 percent of the area, reflecting a requirement of nearness to a retting site.

6. Export of tobacco is not permitted. In view of quality improvements needed to provide all the cigarette tobacco needed, it is questionable whether domestic requirements for this commodity could be satisfied over the planning period. It is assumed that these improvements could occur, but production is arbitrarily limited to the quantity necessary for supplying domestic requirements.

7. Banana export is limited to 200,000 metric tons (M.T.).

8. Export of each livestock commodity is limited to 5,000 M.T. Existing health conditions prevent export of most of these commodities. Permitting limited export quantities in the model gives an indication of situations in which export might be expected to occur if health and sanitary problems were corrected.

These conditions affect the various optimal solutions. Effects on some commodities are so general that they will be touched upon here, rather than in connection with specific solutions [10].

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